

Impact of Smut Disease on Yield and Quality of Sugarcane

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ABSTRACT

Smut has been a significant disease in sugarcane cultivation globally. Being a perennial and monocultured crop, sugarcane faces multifaceted challenges from a range of pests and diseases. Smut is one of the most important sugarcane diseases affecting productivity and sustainability. The disease can cause substantial economic losses by reducing both yield and quality of sugarcane. The economic impact of smut includes not only direct yield losses but also additional costs associated with disease management practices, such as fungicide applications or replanting with disease-resistant varieties. Chronic presence of smut in sugarcane fields can lead to cumulative losses over multiple cropping seasons if not effectively managed. This highlights the importance of integrated disease management strategies to mitigate its impact. In regions where smut is endemic or where environmental conditions favor its spread, growers must be vigilant in monitoring and implementing effective control measures to minimize yield losses and sustain sugarcane production profitability. Research into resistant cultivars and sustainable agricultural practices continues to be crucial in managing this challenging disease.

INTRODUCTION

In India, sugarcane cultivation affected by several significant diseases that can impact yield and quality. Some of the major diseases of sugarcane in India include Red Rot caused by *Colletotrichum falcatum*,

Smut caused by *Sporisorium scitamineum*, Ratoon Stunting Disease caused by *Leifsonia xyli* subsp. *Xyli*, Grassy Shoot Disease caused by *Phytoplasma* spp, Sugarcane Mosaic Virus (SCMV) and Bacterial Leaf Scald caused by

Xanthomonas albilineans. Sugarcane smut, caused by *Sporisorium scitamineum* (Syd.) M. Piepenbr., M. Stoll & Oberw., is one of the most important diseases of sugarcane worldwide and can cause significant yield losses in susceptible varieties (Comstock 2000). Sugarcane is the C4 plant with a complex polyploid nature. A healthy plant has a normal photosynthetic rate and is rich in sugar content. However, once attacked by *S. scitamineum*, alternation into plant physiology occurs. The pathogen alters the photosynthetic rate and diseased plant has reduced sugar content. The pathogen also inhibits the expression of the defense-related genes (Rajput., 2021). These diseases pose significant challenges to sugarcane growers in India and require integrated management approaches including the use of disease-resistant varieties, cultural practices, chemical treatments, and sanitary measures to minimize their impact on crop production.

Smut disease in sugarcane can cause significant yield losses depending on various factors such as pathogen races, environmental conditions, cultivar genotype and the interaction among these three factors. It is believed to have originated in Southeast Asia and spread to other sugarcane-growing regions through infected planting material and natural dispersal mechanisms. Smut has similarity to other diseases that spread rapidly via spores carried in atmospheric air movements. Rapid wind-mediated smut spread has strong implications for disease management.

In severe cases where a large percentage of plants are infected, yield losses can be substantial. It impacts sucrose content where the smut-infected plants may have reduced sucrose content in the stalks, which directly affects the quality and market value of sugarcane. Infected plants often exhibit stunted growth and reduced vigor. This can lead to fewer tillers and smaller stalks, ultimately resulting in lower overall biomass and yield.

Besides yield reduction, smut-infected stalks may also suffer from other quality issues such as increased fiber content or lower juice purity, further impacting the economic value of the crop. The affected plants are severely stunted and yield losses may have a range of 12–75%. These are common in susceptible genotypes. However, a total crop failure may be possible, if susceptible cultivars are grown and climatic conditions are favorable for infection (Croft., B.J., 2000)

Symptoms:

External Galls: Infected stalks may show external galls covered with black spores, which can easily spread to healthy plants through wind, rain, or physical contact. The symptoms of smut in sugarcane can vary depending on the stage of infection and the severity of the disease. Here are the typical symptoms.

Internal Symptoms:

Gall Formation: Infected shoots and buds develop elongated, swollen galls or tumors. These galls can vary in size and are often more noticeable on young shoots and internodes.

- **Discoloration:** Infected tissues inside the galls may appear darkened or discolored.

2. External Symptoms:

- **External Galls:** Mature galls eventually rupture, releasing a powdery mass of black spores (teliospores) on the outside of the stalks. These galls are prominent and can cover significant portions of the affected stalks.
- **Powdery Mass:** The black spores give infected stalks a distinctive appearance, often described as having a "smoky" or "sooty" look.

3. General Plant Symptoms:

- **Stunted Growth:** Infected plants may exhibit stunted growth and reduced vigor compared to healthy plants.
- **Reduced Yield:** Severe infections can lead to significant yield losses as the disease affects the overall health and productivity of the sugarcane crop.

4. Spread and Secondary Infections:

- Smut can spread rapidly under favorable conditions, particularly through wind-dispersed spores or through contaminated planting material. Secondary infections or other opportunistic pathogens may take advantage of weakened plants, further complicating the health of the crop.



Management: It's important for sugarcane growers to monitor their fields regularly for signs of smut and to implement management strategies promptly to minimize the impact of this fungal disease on crop yield and quality. In most sugarcane industries, the primary smut management tool is resistant

1. Use of Disease-Free Planting Material:

- Start with certified disease-free planting material to prevent introducing the pathogen into new areas.

2. Crop Rotation and Sanitation:

- Rotate sugarcane with non-host crops to break the disease cycle.

- Remove and destroy infected crop residues to reduce inoculum levels.

3. Chemical Control:

- Fungicides Hexaconazole (0.2%) and Propiconazole (0.1%) can be used preventatively or curatively to manage smut, though resistance can develop over time.
- Application timing and choice of fungicide are critical for effectiveness.

4. Biological Control:

- Some biocontrol agents have shown promise in managing smut, offering a more sustainable approach compared to chemical treatments. Use of metabolites appeared more effective than spore suspension or multiplied cultures [Srivastava, 2006]. Recently, it was found that a sugarcane smut fungus effector can mimic the host plant elicitor peptide to compete its perception and, thus, suppress the receptor-activated immunity, which may give us a new insight on biocontrol [Ling., 2021].

5. Genetic Resistance:

- Developing and planting sugarcane varieties resistant to smut is a long-term strategy for disease management.
- Breeding programs focus on identifying and incorporating resistance genes from wild and cultivated sugarcane relatives.

6. Cultural Practices:

- Optimize irrigation and fertilization practices to promote plant health and vigor, reducing susceptibility to diseases like smut.



CONCLUSION:

Smut remains a challenging disease for sugarcane growers worldwide. Effective management strategies involve a combination of cultural practices, chemical treatments, biological control, and the use of resistant cultivars. Continuous research and collaboration among researchers, growers, and agricultural experts are essential to mitigate the impact of smut on sugarcane production

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