

## Study of the Smut disease in Sugarcane Crops

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### Introduction:

Sugarcane is a C<sub>4</sub> plant. Sugarcane is a native of India and has been in use for gur making since prehistoric times. The smut disease of sugarcane caused by *Sporisorium Scitamineum* (Sym. *Ustilago Scitaminea*) is one of the major disease of sugarcane. The first time reported the disease incidence came in 1887 from Natal, South Africa (Luthra et al., 1940). Smut infection causes reduction in intermodal length, cane thickness and number of millable canes, lastly affects the yield of the crop. Losses due to smu range from 30-40 per cent in plant crops and even up to 70 per cent in ratoons crops (Kirtikar and Verma, 1962; Sandhu et al; 1975). Source content of infected cane is reduced to 3 to 7 per cent. Stem or *Culmicoloussmut* of sugarcane is cosmopolitan in distribution, and at one time or another has been important in nearly every sugarcane producing country of the world. The disease has since become wide spread in most of the sugarcane producing regions or countries of the eastern hemisphere.

This disease is also called carbon disease, this disease occurs all over India. Many good Varieties have been rejected in selection stage due to susceptibility to this disease. When the disease is manifested in the early stage of the crop, a clump may be totally lost due to non-development of millable cane stalk in the clump. When occurring in older stalks, a part from reduction in growth, there is reduction in sugar content. The disease is easily controllable as compared to red rot. It is easy for a good farmer to cultivate susceptible varieties and yet avoid significant incidence of the disease, by rigorous adoption of control measures. By mutual cooperation between farmer and sugar mill management, smut disease can be kept under

check and as such, there can be no justification in rejection of varieties due to susceptibility to this disease.

#### **Taxonomy:**

The sugarcane smut pathogen was first described and identified in 1870 (Mundkur, 1939) as *Ustilago sacchari* Rabenh; a name which had originally been ascribed to an ovary colour smut attacking the flowers of *Erianthus ravennae* Beauv. The pathogen is identified by its dark brown, minutely punctate teliospores (5.5-7.5 µm diam.) with a thin episore. *Ustilago scitaminea* is pathogenic to sugarcane (*Saccharum officinarum*), other *Saccharum* species (*S. spontaneum*, *S. sinense*, *S. robustum*).

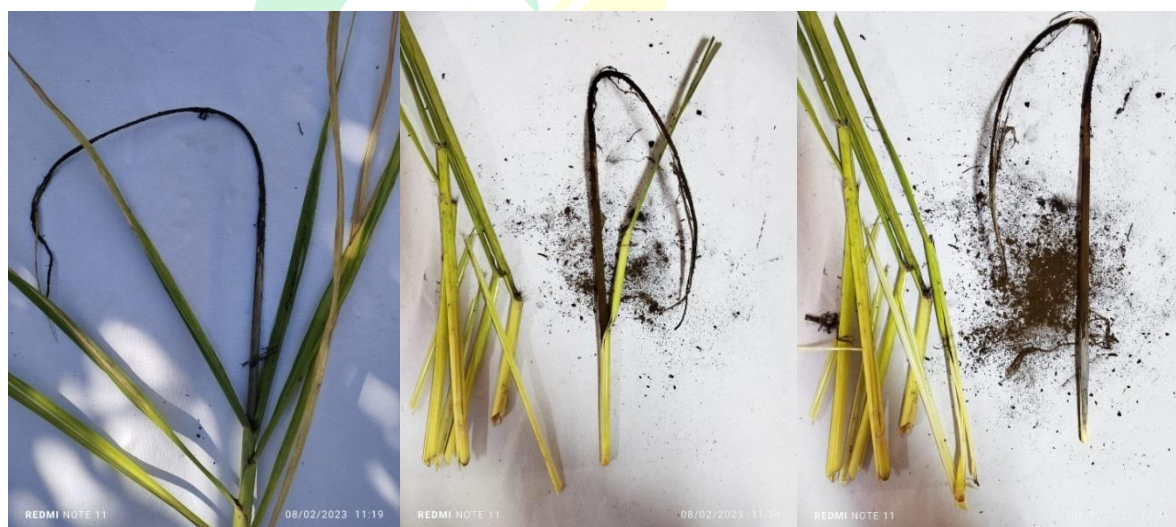
#### **Smut pathogen taxonomy:**

Kingdom: Mycota  
Division: Eumycota  
Sub division: Basidiomycotina  
Class: Ustilaginomycetes  
Sub class: Ustilaginomycetidae  
Order: Ustilaginales  
Family: Ustilaginaceae  
Genus: *Sporisorium*  
Species: *scitamineum*

#### **Symptoms:**

Smut disease of sugarcane causes considerable yield losses and reduction in cane quality (Ferreira & Comstock; 1989). This disease is obvious whip-like smut, which was one of the first diseases of sugarcane to be recognized. Whips arise either from the terminal meristem or from lateral shoots of infected stalks. They vary in length from a few centimeters to approximately 1.5m, with terminal whip usually longer than those originating from lateral shoots. The sorus is comprised of a central core of parenchymatous and fibrovascular elements surrounded by a thin cylinder of teliospores. This teliospore cylinder is in turn surrounded by a thin, silvery membrane that ruptures over a period of several weeks, allowing wind dispersal of teliospores to occur over an extended period of time. Whips grow up to 10 cm per week, and dispersal may take as long as 3 to 4 months to be completed.

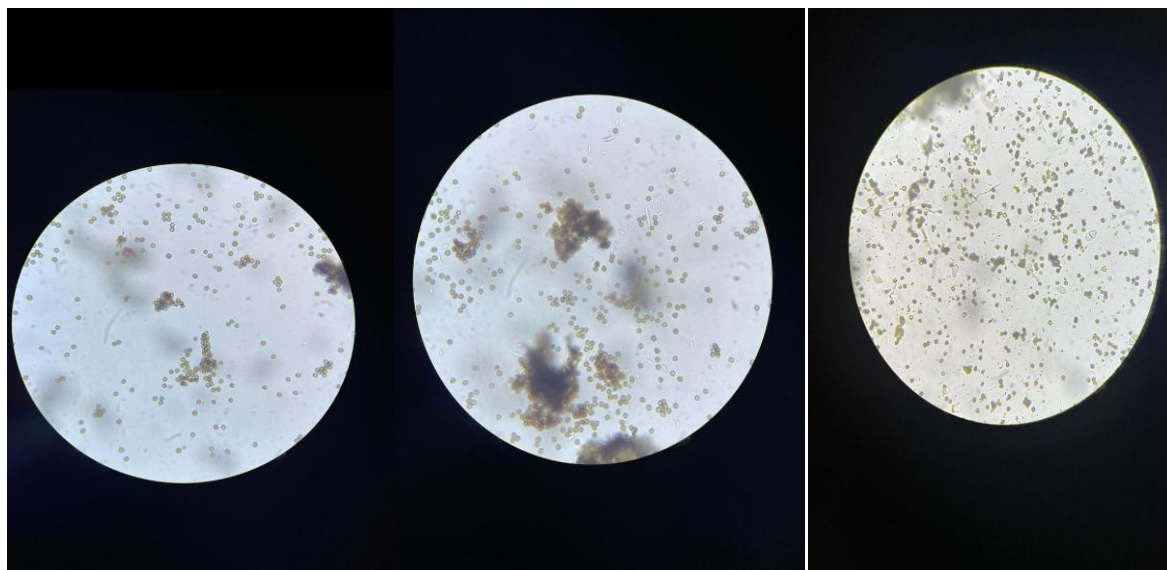
During its life, a typical smut whip will produce and release approximately  $10^8$  to  $10^9$  teliospores/day (Lee-Lovick, 1978).



**Fig. 1. Different forms of whip morphology in smut infected sugarcane plants.**

#### **Biology of pathogen:**

Its pathogen's teliospores germinate readily under moist conditions, each giving rise to a promycelium of variable dimensions averaging  $16\mu\text{m}$  long by  $3$  to  $4\mu\text{m}$  wide and usually divided transversely into three or four cells. Each of these cells is capable of producing sporidia (Basidiospores), sometimes five or six at a time. The sporidia are hyaline and oval-shaped and measure approximately  $6$  by  $2\mu\text{m}$ .

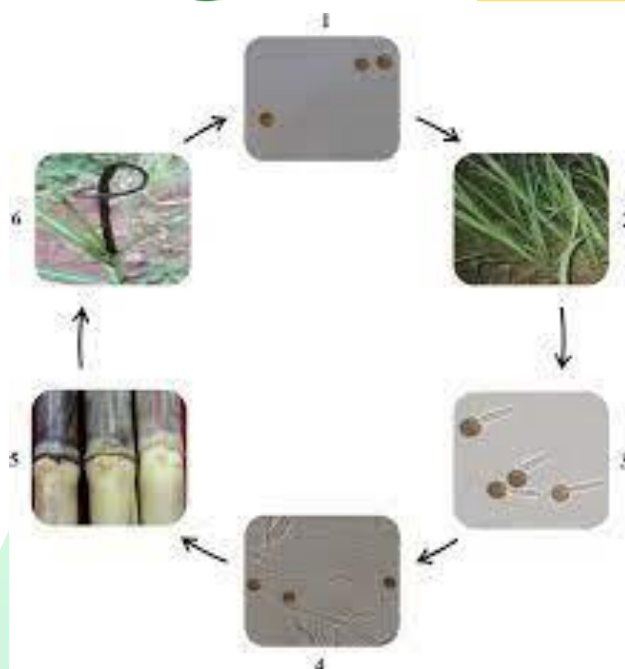


**Fig.2.Smut Teliospores and Its Germination.**

**Pathogen:**

Infection is initiated after teliospores are deposited on lateral buds of standing cane. Teliospores germinate to produce the infectious, dikaryotic hyphae that penetrate the basal portion of bud scales and invade the meristematic region of the bud (Dastur, 1920; Bock, 1964; Waller, 1970). Germination of smut spores occurs on the internodal surface, which was followed by the formation of appressoria on the inner scales of the young buds and on the base of emerging leaves. Entry into the bud meristem occurs between 6 to 36 hours after teliospore deposition (Alexander & Ramakrishnan, 1980). Sexuality has been demonstrated in the smut pathogen by Alexander and Srinivasan (1966), who showed that it was bipolar, that a combination of two sporidia belonging to opposite sexes was necessary for successful infection and degree of virulence varied with the combination of haplotypes. Piepenbring et al. regrouped the generic position of the sugarcane smut pathogen and renamed it as *Sporisorium scitamineum*. The sugarcane smut fungus developed sori with whip-shaped axes corresponding to columellae and hence for the, *U. Scitaminea* is called *S. scitamineum*.





**Fig.3. Disease Cycle of Smut Pathogen in Sugarcane Crop**

**Alternate hosts:**

Sugarcane smut has been reported only a few other members of the gramineae. In Natal, South Africa, natural infection occurred on *Imperataarundinacea* and *Erianthus Saccharoides* (Mc Martin, 1945).

**Economic importance:**

It is certain, however that losses may be quite severe in susceptible varieties under conditions suitable for disease development. Antoine (1961) noted several reports of more than 50 per cent yield reduction, while Lee-Lovick (1978) reported estimates ranging from nearby 73 per cent.

**Management strategies:**

To control measure of smut, several different approaches are used. These include:-

1. Using disease free planting material to controlling smut has been particularly successful in countries where the disease does not come severe or where moderately resistant varieties are planted (Antoine, 1961; Lee-Lovick, 1978). Growing of resistant and moderately resistant varieties viz., Co 15024, Co 15027, CoLk 15201, CoLK 15203, CoLK 15204, CoLK 15205, CoPb 15212, CoLK 14201 should be used.

2. Crop rotation with the non- host crop to decrease soil-borne inoculums was recommended by Antoine (1961) for smut control. Rotation crops suggested were Lucerne or Maize.
3. The use of resistant varieties is the best approach t smut control. The research stations test varieties for resistance and then only release them for general cultivation by the farmers.
4. Removing smutted clumps: In young stage, particularly in ratoons, the disease is identified by proliferation of shoots and even appearance of small tiny black whips. In older crops, long black whip are prominent. Disease clumps are to be whally covered by fine muslin bag and up rooted and burnt away from the field.
5. Pre-treatment of seed: Sugarcane setts are to be pre-treated before planting. This pre-treatment is generally a combination of heat cum chemical. In hot water pre-treatment, described in detail elsewhere, chemical like aretan, agallol are also added to the water at the ratio of about one ounce to a gallon of water. In such pre-treatment, smut spores are killed and incidence of the disease is very much reduced.
6. Hot water treatment (HWT) at 50°C for two hours is effective for the management of the disease. Moist-heat-air (MHT) treated (54°C for 2.5 hours) seeds use for the management of the disease in sugarcane crop. Treating the setts with Areated Steam therapy (AST) at 50°C for one hour. Roguing of smut whips with gunny bages/polythene bag and dipped in boiling water for 1 hour, and diseased clums must be uprooted and burnt.
7. Mixture of press mud and *Trichodermaviridae* and *Trichodermaharzianumis* found effective in disease management.
8. Sett treatment with Carbendazim (0.2%) .
9. Carboxin – trade name – Vitavax is highly effective against Smut pathogen. Spray on infected stools with a small amount of a 10% solution of roundup, using a small hand head sprayer.

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