



Detail Study of Smut Disease of Sugarcane

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Sugarcane (*Saccharum* sp. hybrids) is a C₄ plant belonging to family- Poaceae (Gramineae), class-Monocotyledons and, Order- glumaceae, Subfamily- Panicoidae under tribe- Andropogoneae, sub tribe-Saccharininea and Genus-*Saccharum* cultivated globally in the tropical and subtropical regions. It is one of the important cash crops which provides raw materials to sugar industry and jiggery (Gur) units. Gur was mainly known as early as 3000 BC. The name of the raw sugar (Gur) has originated from the word "Gaura". The importance of sugar in human diet needs. Sugar is produced mainly from sugarcane and sugarbeet. More than 75 percent of the world sugar comes from sugarcane. Sugarcane remained an important commercial crop of agriculture and trade in India contributing substantial revenue to the exchequer by way of tax and duties. Today, it is fast transforming into the most sought after renewable energy crop, as the demand for ethanol is increasing as an alternative green fuel for the automobile. Currently Brazil is 50 percent of its sugarcane for the production of ethanol and blending ethanol with petrol to the tune of 25 percent. India is hoping to blend ethanol at least up to 10 percent in the near future. It has been estimated that India will need 495million tones of sugarcane by 2025 AD to meet both sugar and energy demands (Yadav and Duttamajumder, 2007).

Taxonomy of Sugarcane

The detailed taxonomy of sugarcane is presented below:

Kingdom: Plantae

Superkingdom: Tracheobiont

Superdivision: Spermatophyta

Division: Magnoliophyta

Class: Liliopsid

Subclass: Cmmelinidae

Order: Cyperals

Family: Poaceae

Genus: *Saccharum*

Species: *officinatum*

Sugarcane, *Saccharum officinarum* L., is the world's largest commercial crop, which is cultivated in more than 120 countries on about 26.27 million hectares, with a worldwide harvest of 1.90 billion tones. Approximately 80 per cent of the world sugar is derived from sugarcane. Harvesting of sugarcane provides hundreds of tones of green matters per hectare each year, and provides 75,000 millions calories each year. The sugarcane crop requires 12-14 months for maturity and harvesting. The important sugarcane producing countries are Brazil, India, China, Pakistan, Mexico, Colombia, Indonesia and Philippines. India is the

second largest producer of sugarcane in the world next to Brazil. Brazil and India produce 59 per cent of the world's total yield. Indonesia rank 11th with Sugarcane Production.

Table1: World Sugarcane Area, Production and Productivity

| S.N. | Country | Production (tones) | Per Person Production (Kg) | Area (ha) | Productivity (Kg/ha) |
|------|-----------|--------------------|----------------------------|------------|----------------------|
| 1. | Brazil | 768,678,382 | 3,668,531 | 10,226,205 | 75,167.5 |
| 2. | India | 348,448,000 | 260.721 | 4,950,000 | 70,393.1 |
| 3. | China | 123,059,739 | 88.287 | 1,675,215 | 73,459.1 |
| 4. | Thailand | 87,468,496 | 1,264.303 | 1,336,575 | 65,442.2 |
| 5. | Pakistan | 65,450,704 | 324.219 | 1,130,820 | 57,879 |
| 6. | Mexico | 56,446,821 | 452.524 | 781,054 | 72,270 |
| 7. | Colombia | 36,951,213 | 740.075 | 416,626 | 88,691.5 |
| 8. | Australia | 34,403,004 | 1,373.406 | 447,204 | 76,929.1 |
| 9. | Guatemala | 33,533,403 | 1,938.114 | 259,850 | 129,049.3 |
| 10. | U.S.A. | 29,926,210 | 91.304 | 370,530 | 80,766 |
| 11. | Indonesia | 27,370,546 | 210.232 | 410,104 | 54,548.5 |

<https://sugarcane.dac.gov.in>

The major sugarcane growing states of the country are Uttar Pradesh, Maharashtra, Karnataka, Tamil Nadu, Andhra Pradesh and Bihar. In sugarcane crop, five agro-climatic zones have been identified by all India coordinated research project on sugarcane. Sugar industry is the second largest in country after cotton textiles and contributes around 6 per cent of total agriculture GDP.



Fig1: Production of Sugarcane Crops

Table 2: Area, Production and Productivity of sugarcane in major states of India during 2020-21

| S.N. | States | Area (Lakh/ha) | Production (Million/tones) | Productivity (Tones/ha) |
|------|---------------|----------------|----------------------------|-------------------------|
| 1 | Uttar Pradesh | 21.77 | 177.43 | 81.50 |
| 2 | Maharashtra | 12.32 | 113.37 | 92.00 |
| 3 | Karnataka | 5.88 | 56.45 | 96.00 |
| 4 | Tamil Nadu | 1.45 | 14.53 | 100.00 |
| 5 | Bihar | 2.11 | 13.97 | 66.25 |
| 6 | Gujarat | 2.23 | 17.44 | 78.31 |
| 7 | Haryana | 1.08 | 8.75 | 81.23 |
| 8 | Punjab | 0.88 | 7.51 | 85.34 |

| | | | | |
|----|----------------|-------|--------|-------|
| 9 | Andhra Pradesh | 0.47 | 3.65 | 77.75 |
| 10 | Uttarakhand | 0.44 | 3.52 | 80.00 |
| 11 | Madhya Pradesh | 0.94 | 5.45 | 58.00 |
| 12 | Telangana | 0.29 | 2.22 | 76.40 |
| 13 | West Bengal | 0.19 | 1.52 | 80.00 |
| 14 | Others | 0.93 | 4.70 | 50.39 |
| | All India | 50.98 | 430.50 | 84.44 |

Source – E&S, DAC, New Delhi, 3rd Adv. Est. -2021-22

A look at the world Atlas of Sugarcane reveals that in spite of tropical origin it is successfully grow even 12 degree beyond the tropic of cancer and Capricorn (23.5 ° N&S of the equator ; 37° N south Spain , 30° S) Natal, South Africa. However, in any geographical location, prevailing Agro-Cliatic conditions and edaphic factors influence the duration and productivity of the cane crop.

The smut disease of sugarcane caused by *Sporisorium scitamineum* (Sym: *Ustilago scitaminea*) is one of the major disease of sugarcane. The first reported the disease incidence came in 1887 from Natal, South Africa (Luthra et al., 1940). Before 1950s, sumt disease was not a major disease of sugarcane producing countries except Fiji (Ramesh Sunder et al., 2012). Smut infection causes reduction in inter nodal length, cane thickness and number of millable canes which lastly affects the yield of the crop. Losses due to smut range from 30-40% in plant crops and even up to 70% in rations crop (Kirtikar and Verma., 1962; Sandhu et al., 1975). The disease caused severe yield loss to sugarcane for long time in Maharashtra and Northern Karnataka regions till the variety Co 740 was under cultivation. The disease was responsible for the elimination of many commercial high yielding varieties and has been the major causes of varietal decline of some superior varieties like Co 419, Co 1148, Co 740, Co 0238, CoJ 64, Co 1158, CoLK 7701, CoLK 11203 and CoS 91269. The impact of disease is still felt in some part of Maharashtra, Karnataka and Gujarat. Varietal susceptibility for multiple ratoon crops. Severe smut infection affects the cane yield and sugar recovery. In India, the yield loss due to smut disease is reported up to 50% (Viswanathan and Rao, 2011).

Causal Organism: *Sporisorium scitamineum*

In case of whip smut pathogen, *S. scitamineum*, the detection of diversity in earlier studies was mainly based on the specific cultivar's response to pathogen infection and subsequent disease development. A report smut that the first race of *S. scitamineum* designated as 'Race A' was first recorded in Hawaii (USA) in 1971 and 'Race B' in 1976. Seven major commercial varieties evaluated against whip smut disease under field conditions by artificial infestation with *S. scitamineum* at Guangxi bordering Taiwan and Guangdong (China) also revealed the possibility of presence of race 1, 2 and 3.

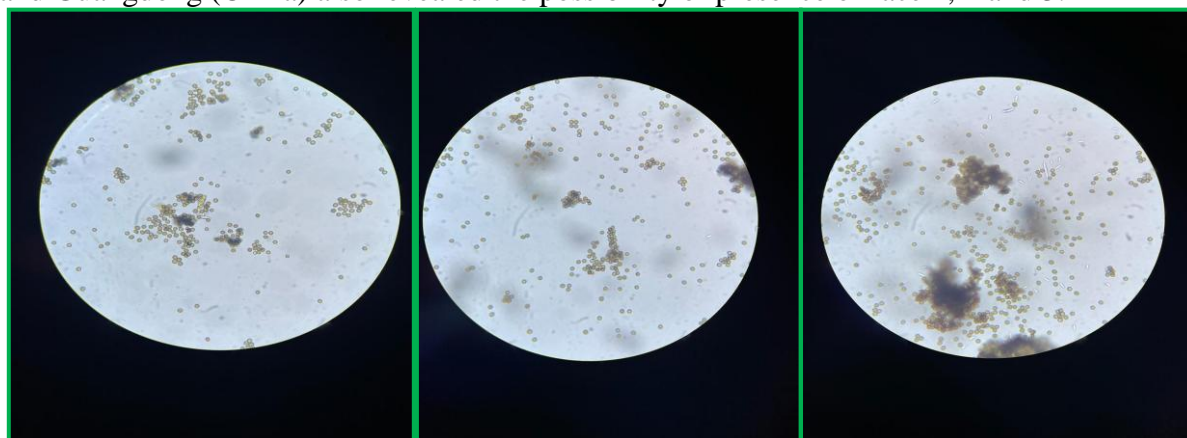


Fig 2: Sugarcane Teliospores and its Germination

Taxonomy of Smut Fungi

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

Pathogenicity of the Smut Pathogen: A detailed study on pathogenicity of smut pathogen was conducted by Alexander and Ramakrishnan, (1978) established parasitism, teliospore germination, dikaryotisation and infection, Infected setts are the major source for the disease transmission in the field. Systemically infected plants do not always show whip symptoms but most of the buds in them will be infected by the pathogenes and if such symptoms less canes are used as seed material, it would serve area source for primary transmission. The secondary spread of disease takes place in the field through air-borne teliospores and the spores present in the soil are carried to different field through rain or irrigation water. Hot and dry weather conditions generally favour the smut disease in the field. Under high stress conditions the cultivars may show symptoms of whip development, otherwise they normally do not produce whips symptom.

Symptoms: Sugarcane smut can be diagnosed through black Whip-like structure that from the growing point of the sugarcane plant. The symptoms of this disease appear after 2 to 3 months of sowing sugarcane crops. Whip are formed in the shoots developing from smut infected cane through cutting cane that is infected from spores attached to the bud, shoots developing in contaminated soil and from side shoots developing on mature stalks. It spore are thin, long, unbranched, black whip-shaped. Smut whip emerges from top of the disease sugarcane plant, will be up to one meter in length. Sometime the cotyledon is small and remains inside the leaf sheath. Liniment is made up of parenchymatous to vascular tissue. Initially it is covered with the white transparent membrane. Underneath the membrane there is a black layer in which numerous tuber-spores are filled. As soon as the membrane burst, the spores spread in the air. Sometimes other symptoms are seen in addition to the main symptom, galls are formed on the leaves. There are two types of tuber infection in sugarcane – primary and secondary. Primary infection is spread by sugarcane setts, secondary infection is spread by wind in the month of October – November (Autumn).



Fig 3: Different forms of Whip Morphology on Sugarcane Smut Pathogen

Diseases cycle: Its smut pathogens teliospores are present in the soil. The primary transmission of this pathogen is by seed and secondary transmission is by air, water and insects. After 3 to 5 months of sowing the seed of diseased sugarcane, kamchi emerges. There are about 10 to 50 million spores in a kamchi. It is estimated that if one spore reaches one eye of sugarcane, then only a few kamchi spore can harm the entire crop of India. The spores of the fungus are carried from one place to another by wind, water on insects and remain dormant in the soil.

Seed selection and treatment:

- ❖ Seed are selected from disease and insect free, 100 per cent pure crop of progressive species recommended from approved nurseries, development from Moist-heat-air (MHT) treated (54°C for 2.5 hours) seeds.
- ❖ The setting of upper 2/3 of the sugarcane is relatively good and the setting of seed taken from 7 to 8 months crops is also relatively good as compared to 12 months crop.
- ❖ Before planting, cut the pieces of sugarcane with two or three eyes by pit or sett cutting machine, remove the diseased, porous and dry eye pieces.
- ❖ Treated sugarcane pieces by immersing them in Bavistin (Carbendazim 0.2%) solution for 30 minutes.
- ❖ For sowing in summer, after immersing the sugarcane pieces in water for 8 to 10 hours, treat them with the above method and sow them.

Management strategies

Cultural method:

- ✓ 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.
- ✓ Healthy seed should be used for sowing.
- ✓ Ratoon crop should be avoided.
- ✓ The removal infected disease plants from the fields.
- ✓ Deep summer ploughing during the summer to expose the pathogen.
- ✓ Mixed and intercropping
- ✓ Crop rotation

Physical method:

- ✓ 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.

Biological method:

- ✓ Mixture of press mud and *Trichoderma viridae* and *Trichoderma harzianum* is found effective in disease management.
- ✓ *Baveria bassiana* and *Metahrizium anisophilae* use for the controlling of insect intraction.

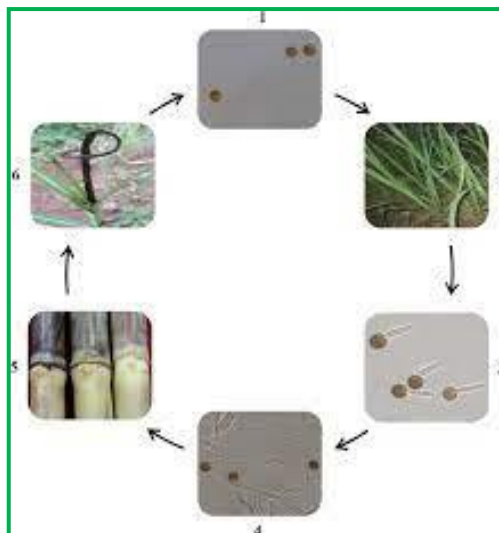


Fig 4: Disease cycle of Smut Pathogen in Sugarcane Crops

Chemical method:

- ✓ Sett treatment with Carbendazim (0.2%).
- ✓ 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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