

Ratoon Stunting of Sugarcane and Its Management

*Swrana Kurmi, A. K. Jain, Jayant Bhatt and Sanjay Kharte

Department of Plant Pathology College of Agriculture, JNKVV, Jabalpur

*Corresponding Author's email: prachikurmi24@gmail.com

Leifsonia xyli subsp. *xyli* is the causative agent of Ratoon Stunting Disease (RSD), one of the most commercially important bacterial diseases affecting sugarcane. RSD can cause significant yield losses by decreasing cane weight, juice quality, and tiller populations, especially in ratoon crops, even in the lack of noticeable outward signs. Infected planting material and mechanical transfer through contaminated tools and equipment are the main ways that the illness spreads. The use of disease-free seed cane, hot water treatment (HWT), frequent sterilization of cutting instruments, and the development of resistant or tolerant cultivars are all essential components of an integrated strategy for the effective management of RSD. To stop and manage the development of RSD, stringent phytosanitary procedures and farmer education initiatives are essential. To increase sugarcane cultivation's productivity and profitability, ratoon stunting must be managed sustainably.

Causal organism

Leifsonia xyli subsp. *xyli* (Lxx) (Evtushenko *et al.*, 2000), an RLO (Rickettsia like organism). Formerly known as *Clavibacter xyli* subsp. *xyli* (Davis *et al.*, 1984).

Systemic position

Domain: Bacteria

Phylum: Actinomycetota (formerly Actinobacteria)

Class: Actinomycetia (formerly Actinobacteria)

Order: Micrococcales

Family: Microbacteriaceae

Genus: *Leifsonia*

Species: *Leifsonia xyli*

Subspecies: *Leifsonia xyli* subsp. *xyli*

Introduction

Sugarcane (*Saccharum officinarum* L.) is a tall, perennial grass belonging to the family Poaceae. Originating in Papua New Guinea, it is now cultivated in tropical and subtropical regions. It is an important cash crop and renowned for its ability to store high concentrations of **sucrose** (table sugar) in its fibrous stalks, making it the primary source of sugar globally (accounting for about 79% of world sugar production). Its by-products are also highly valuable **bagasse, molasses and press mud**.

The term "**ratoon**" refers to the practice of allowing sugarcane to regrow from the stubble left in the field after harvest, rather than replanting which reduces cultivation costs.

Ratoon Stunting Disease (RSD), caused by a xylem-inhabiting bacterium *Leifsonia xyli* subsp. *xyli* (Lxx), is widely considered one of the most economically damaging and significant diseases of sugarcane worldwide. This pathogen resides within the water-conducting vessels (xylem), impeding the flow of water and nutrients, which ultimately leads to reduced plant vigour and significant yield losses.

It mainly affects ratoon crops and is often referred to as the "invisible disease" due to its lack of obvious external symptoms, making its detection and management challenging. RSD is caused by the transmission of *Lxx* bacteria through contaminated harvesters, farm machinery, and infected planting materials.

History

1944-1945: First Discovery and Initial Observations (Australia)

- RSD was first observed and reported by BSES (Bureau of Sugar Experiment Stations) pathologists in Mackay, Queensland, Australia.
- First identified on the sugarcane variety Q28, where it was noticed to severely stunt growth, especially in successive ratoon crops. It was initially known as "Q28 disease."

Early Years (1940s-1960s): The "Invisible Disease" Era and Viral Hypothesis

- For decades, RSD was a mystery, given the lack of a culturable pathogen, it was initially thought to be caused by a **virus (Steindl, 1961)** due to its lack of distinct external symptoms and nicknamed it as 'invisible disease'.
- Internal symptoms, such as the characteristic orange-red discoloration of vascular bundles in the nodes when split longitudinally, were noted by Steindl in 1950.

1970's: In 1973, Gillaspie et al., Maramorosch et al., and Teakle et al. independently reported the presence of a bacterium in the xylem vessels of RSD-affected sugarcane.

1980: The causal bacterium was successfully **isolated in pure culture** by Davis et al., allowing for definitive proof of its role.

1984: The bacterium was formally classified as *Clavibacter xyli subsp. xyli* by Davis et al.

2000: Based on advanced molecular analysis, it was reclassified to its current scientific name, *Leifsonia xyli subsp. xyli* by Evtushenko et al.

Occurrence

- **Worldwide:** Bangladesh, China, Myanmar, Malaysia, Sri Lanka, Pakistan, Philippines, Taiwan, Thailand, Africa, Europe and North, South and Central America.

India: Bihar, Haryana, Punjab, Karnataka, Madhya Pradesh, Tamil Nadu and Uttar Pradesh.

Economic losses

Studies have shown cane yield losses ranging from **12% to 37%** under normal growing conditions. Under severe water stress or drought conditions, yield losses can be as high as **60%**. In Australia, disease incidence can exceed 30% of sugarcane crops, leading to substantial economic impacts. Studies have shown average 3-year losses ranging from 29 to 60 tons per hectare of cane and 2,627 to 7,369 kg per hectare of sugar. One study in Bangladesh (a similar agroclimatic region) found significant losses in cane yield of **21.70% in the plant crop** and **28.12% in the first ratoon crop**. Sugarcane yield losses are primarily caused by diseases, such as rust (20%), smut (75%), ratoon stunting disease (RSD) (40%), and mosaic virus infection (40%), which lead to 37% global agricultural production loss. CO 419 variety was worst affected in some parts of Karnataka by RSD where it was withdrawn from cultivation.

Symptoms

- RSD is notorious for its cryptic nature, meaning it rarely presents clear and easily identifiable external symptoms.
- The most characteristic external symptom is a general **stunting** of growth, which can manifest as uneven appearance in affected fields. During summer, wilting can be seen.
- **Reduced tillering, shortened internodes** and **yellowing of leaves** may also be observed.
- Germinability of setts from diseased canes are very slow with reduced growth.
- However, stunting can also be caused by other factors like drought or nutrient deficiencies, making visual diagnosis unreliable.
- **Internal symptoms**, though more indicative, are also not always consistently present and can vary with the cultivar. These include:

- **Red-orange dots or "commas" in the vascular traces:** When stalks are sliced open longitudinally, especially at the nodal tissue, small red-orange discolorations may be visible in the xylem vessels in matured canes.
- **Faint pink discoloration of the growing point:** In very young plants, a faint pink blush might be observed in the growing tip when split open.
- However, many varieties are symptomless carriers of the presence of RSD can be detected only by using indicator varieties or other artificially inoculates hosts.



Fig.: Red-orange discoloration and yellowing of leaves

ETIOLOGY

- *Leifsonia xyli* subsp. *xyli* (*Lxx*) is a **gram-positive** and **fastidious xylem-limited bacterium** meaning it primarily inhabits the water-conducting vessels (xylem) of the sugarcane plant.
- *Lxx* cells are small, non-acid fast, non-endospore forming, pleomorphic, **striated rods or coryneform** with smooth walls, typically measuring $0.25\text{--}0.5 \times 1\text{--}4 \mu\text{m}$ in length.
- **COLONIES OF *Lxx*:** Appears mucoid, shiny, **non-pigmented**, usually white or cream-colored, **circular** with entire (smooth) margins and **convex**. They are known for being **slow-growing**, often taking **2-3 weeks** to become visible and reach this size.

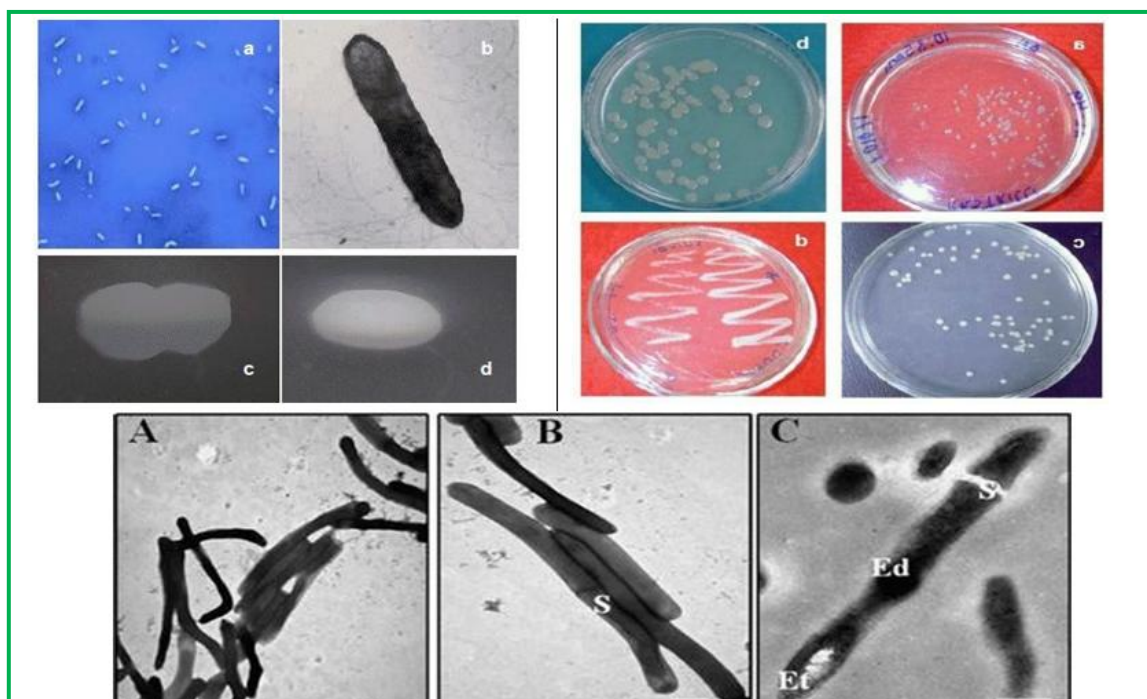


Fig: Shape and colony of *Lxx*

DISEASE CYCLE

- **Primary source:** Infected setts (seed pieces) and ratoon stubble.
- **Entry:** Wounds during mechanical cutting or natural cracks.
- **Spread:** Internally through xylem; externally through contaminated tools (machetes, harvesters).
- **Survival:** *Lxx* cannot survive for long periods in the soil but can persist in plant debris and volunteer sugarcane plants, serving as a reservoir for re-infection.

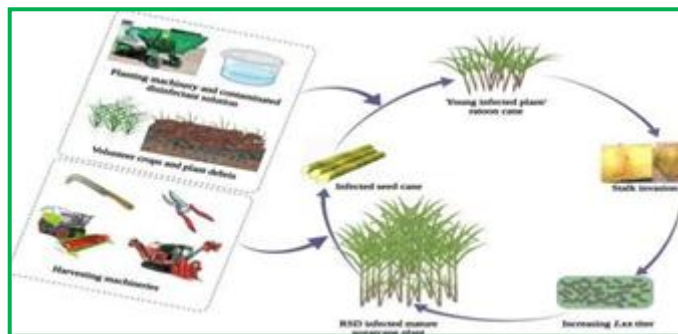


Fig: Disease Cycle

EPIDEMIOLOGY

- Favors **warm, moist conditions** but can persist in a range of environments.
- More severe in fields with frequent ratooning and poor sanitation.
- **Latent infection** is common, aiding unnoticed spread over time.
- **Maize, sorghum, Sudan grass** and ***Cynodon*** are collateral host of this pathogen.

MANAGEMENT

A. Cultural Practices

- Use disease-free seed material (setts).
- Avoid successive ratooning beyond 2–3 crops.
- **Field sanitation:** Remove and burn clumps showing the disease and removal of collateral hosts.
- Use of **RSD-tolerant cultivars** (region-specific).

B. Chemical & Physical Methods

- **Hot water treatment:** Setts treated at 50°C for 2–3 hours or 52°C for 30 minutes suppressed the disease by 22.6%.
- **Hot air treatment:** Setts are treated with inlet air at 54°C for 8 hours.
- **Aerated steam therapy (AST):** 50°C steam for 1 hour.
- **Chemical sett treatment:** Benzylpenicillin and streptomycin used in sett piece treatment.
- **Chemical control:** Application of ammonium sulphate to sugarcane crop helps in reducing this disease.

D. Mechanical Hygiene

- Disinfect cutting tools and equipment before use with **bleach or alcohol**.

References

1. R. S. SINGH, Plant diseases, 9th edition
2. https://www.researchgate.net/publication/225165639_Ratoon_stunting_disease
3. https://agritech.tnau.ac.in/crop_protection/crop_prot_crop%20diseases_cash%20crops_sugarcane.html
4. <https://sugarresearch.com.au>
5. <https://pmc.ncbi.nlm.nih.gov/articles/>
6. <https://www.fao.org/> The economic importance of sugar and sugar cane - problems and perspectives - k.s. Mulherin
7. <https://apsjournals.apsnet.org/doi/10.1094/PHYTO-05-23-0181-RVW>