

The cancer (red rot) of sugarcane causes symptom and prevention

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Abstract

India the most important crops is sugarcane. The second largest production agro based industry. Sugarcane is the prone to the number of disease causes by pathogens viz. fungi bacteria virus and phytoplasmas like organism the fungal disease named red rot of sugarcane is the threatening diseases of sugarcane. It is also known as cancer of sugarcane. It causes severe loss in yield and quality of the sugarcane. The colletotrichum falcatum responsible for this disease. Its causes frequent breakdown of resistant varieties. In the present review summarizes the causes symptom and prevention of these red rot cancer of sugarcane.

Key words – Sugarcane , colletotrichum falcatum, resistance,

Introduction

Sugarcane (*Saccharum* spp.) is a commercially important crop of tropical and sub-tropical regions cultivated primarily for production in the world. It is valuable mainly because of its ability to store high concentrations of sucrose, and sugar, in the stem. More Recently for the production of ethanol, which is an important renewable biofuel source [1,2,3]. Brazil is the largest sugarcane producer, contributing with 40% were incompletely world production, followed by India, China, Thailand, Pakistan, Mexico, Philippines, United States, Australia and Argentina [3,4].

Sugarcane is responsible for 75% of the global sugar production and India is the largest consumer and second largest producer of sugar in the world.[5]The sugarcane producing states of India and their contribution in sugarcane production is shown in **Figure 1**. Indian sugar industry is the second largest agro based industry, next only to the textiles. But, being a long durational crop, sugarcane is prone to the number of disease caused by pathogens viz. fungi, bacteria, viruses and phytoplasmas like organisms. Amongst all the diseases, red rot and smut are causing the major outbreaks in the recent years causing 30-100% yield loss in commercial sugarcane cultivars throughout India [6].

The crop is caused by many diseases and maximum devastation occurs due to red rot caused by fungus *Colletotrichum falcatum* Went [7]. The pathogen attacks sucrose accumulating parenchyma cells [8] of economically important cane stalk [9] leading to severe losses in sugar recovery (25–75%), extraction (7.1–32.5%), polarity (7.4–38.7%), purity co-efficient (0.5–8.3%), and commercial cane sugar (7.8–39%) [10,11].

Red rot is also the oldest mentioned disease of sugarcane dating back to the times of Buddha. The disease was first reported from Java, Indonesia, where it was known as “*Sereh*” [12] and generally known to cause by the fungus, *C. falcatum* Went. The perfect stage of the fungus was identified as *Physalospora tucumanensis* Speg. [13] and finally known as *Glomerella tucumanensis* Speg. [14]. Barber Ca [15] recorded the first report of red rot occurrence in India.

Since then a number of red rot epidemics have been reported, especially in eastern Uttar Pradesh, northern Bihar and pockets of Punjab.

Top 10 Sugarcane Producing States : 2014-2015

S.No.	State/ UT	Sugarcane (Th. tonnes)
1	Uttar Pradesh	138481
2	Maharashtra	81870
3	Karnataka	41895
4	Tamilnadu	24463
5	Bihar	14131
6	Gujarat	14060

S.No.	State/ UT	Sugarcane (Th. tonnes)
7	Andhra Pradesh+ Telangana	13150
8	Haryana	7650
9	Punjab	7039
10	Uttarakhand	6135

Fig.1**Causes of red rot disease of sugarcane**

Red rot of sugarcane disease is caused by *Colletotrichum falcatum* Went, the perfect stage of which is *Glomerella tucumanensis* (Speg.) Arx and Muller. There has been considerable difference in opinion as to the nature of the fungus that causes this disease. Some insisted that this fungus is more strictly saprophytic than parasitic, and that it cannot attack healthy canes. The red rot fungus can be readily isolated from infected tissues.

The pathogen produces specialized structures known as acervuli, which support profuse sporulation. Spores (conidia) are hyaline (clear), oblong, single-celled, and produced in a slimy matrix. They rely heavily on water, particularly rainfall, for dissemination. At least six races of the red rot pathogen have been identified (Bharti et al. 2014; Saksena et al., 2013). Fungal growth is affected by temperature, pH, nutrition and environmental conditions.

The mycelium of the fungus grows both inter- and intracellularly in the parenchymatous cells of the host tissue. The hyphae are colourless, slender, freely branched and septate. Acervuli appear just above or below the nodes along the de-pressions or ridges.[16] They are black velvety bodies, develop in clusters. Acervuli are cuspidate with irregularly arranged setae. They are black velvety bodies, develop in clusters. Acervuli are cuspidate with irregularly arranged setae. Aseptate conidiophores long and wide, on which one-celled falcate conidia are borne. Conidia long and broad. They bear large oil globule in the centre. Chlamy-dospores are terminal or intercalary.[16]

Favourable conditions for disease development

- Mean temperature range of 29.4 to 31°C is optimum for the development of the disease [17,18].
- pH 5-6 [19].
- Drought conditions during the initial growth phase [20].
- High atmospheric humidity (90%).
- Water-logged conditions of the soil.
- Continuous cultivation of same variety in the field.

Symptoms of red rot disease of sugarcane

The most damaging phase of this disease occurs when the pathogen attacks the stalk. Depending on the age of the stalk, time of infection and susceptibility of the cane genotype, it produces different types of symptoms [21].

The first external evidences of disease are the drooping, withering, and finally yellowing of the upper leaves. This is followed by a similar wilting of the entire crown, and finally the entire plant shows indications of disease and dies. When not severe, the eyes frequently die and blacken and the dead areas extend out from the nodes.

The protoplasm changes colour and a gummy dark-red material oozes out of the cells filling the in-tercellular spaces. The soluble pigment present in this ooze, is absorbed by the cell wall producing the characteristic red rot appearance.

Discolouration of the leaves is the first symptom in the field. The spindle leaves (3rd and 4th leaf) display drying which withers away at the tips along the margins.

About this time the upper leaves of the stem turn pale and gradually droop down. These leaves then wither at the tips and along the margins. Ultimately the entire plant withers and droops down. In areas where the disease appears in a severe epidemic form, the entire crop withers and droops resulting in a complete loss of crop.

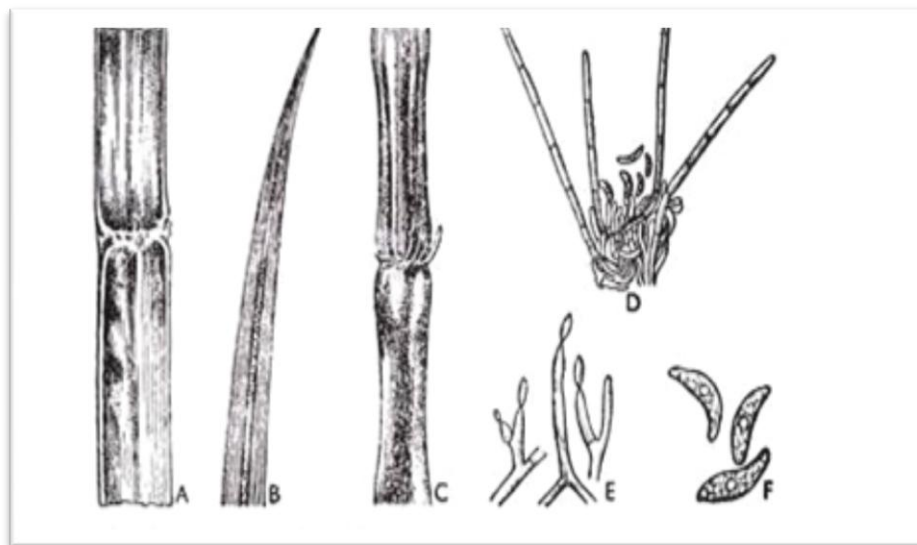


Figure 2:- Red Rot of Sugarcane. A-C Disease symptoms. A and C. On stem. B. On leaf.

D. Anacervulus. E. Conidiophores producing conidia. F. Conidia.

Though the fungus attacks all parts of the host above ground, stems and midribs of leaves are more susceptible to fungal attack. Infection in the leaves is visible along the midribs as dark-reddish zones having tendency to elongate rapidly turning blood-red enclosed by dark margins (**Fig. 2**). When the infection becomes old, the central blood-red colour changes to straw colour.

With the advancement of disease, the stalk becomes hollow and covered with white mycelial growth. Later on the rind shrinks longitudinally with the protrusion of minute black, velvety fruiting bodies. The infected cane emits acidic-sour smell while its juice emits alcoholic smell. As sucrose gets converted to glucose and alcohol in diseased cane, it does not set well upon boiling.

Prevention of red rot (cancer)

Management of red rot has been a challenging area of work. the stalk from which seeds are prepared has been largely affected the time of planting, and fungicides cannot reach the infected tissues inside a diseased seed sett.

The pathologists and sugarcane breeders. The epiphytotic of the disease depends upon weather conditions, genotypes, presence of virulent pathogen and time for disease development. These factors must be studied in depth so as to achieve effective control of the disease. [22].

Therefore careful selection of red rot-free seed setts is recommended for planting. Seed should always be taken from disease-free nurseries examined regularly by the cane protection staff.

Adopting one or more of the following measures can minimize the disease incidence.

- Avoid planting of highly susceptible varieties.
- Follow the long furrow method or pair row method of layout for planting and irrigation.
- Planting material should be collected from the seed nursery.
- Before primary and general cane planting set treatment with 0-1% carbendazim (Bavistin) for 15-20 minutes dipping should be followed.
- Before planting, each seed sett should be carefully examined and those setts which show reddening should be discarded.
- Where facilities are available for hot water treatment of seeds, they can be utilized for controlling red rot of seed (treat in water at 50°C., for two hours). Treating seed with fungicides like Arasan (0.25 per cent.) is often effective.
- The use of sugarcane varieties resistant to red rot is also recommended.
- The possibilities of an epidemic is very much minimized with the practice of long crop rotations (2 to 3 years) where planting is done in plots.
- One of the best ways to reduce the incidence of the disease is to raise healthy stock for planting in plots especially fertilized, cultivated, and kept disease-free by constant care.

Resistant varieties

Effective control of red rot has been mainly through the use of resistant varieties. Even though genetics of inheritance of red rot resistance is not well established, considerable progress has been made in the production of red rot resistant varieties [22]. In India, the breeding work is primarily focused on developing red rot resistant varieties [23]. But as the pathogen is highly variable in nature, therefore, even if a disease resistant variety is released for cultivation, it gets susceptible to red rot disease within 8–10 years because of the development of new more virulent races of the pathogen [24,25].

From the last few decades, molecular diagnostic tools have increasingly been used as an alternative to traditional techniques [26]. Molecular markers could be used as an effective means that can unfold the complex genetics of sugarcane and also aid the breeders in improving the genetic makeup of varieties [27,28]. So far, sugarcane diversity has been studied using ribosomal DNA [29], simple sequence repeats [30]; amplified fragment length polymorphism [31]; restriction fragment length polymorphism [32]; TRAP and

random amplified polymorphic DNA [33]. Considerable efforts are going on to identify genes and develop markers associated with red rot resistance.[34]

Cultivation of resistant varieties like Co 89003, Co 98014, Co 0118, Co 0238, Co 0239, Co 0124, Co 975, Co 1148, Co 1336, Co 6611, Co.S 561, Co.S 574, B.O.s 3, etc will contain the disease.s

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