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Recent Advances in Control of Red Rot in Sugarcane – An Overview

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Abstract: *Sugarcane is cash crop grown commercially throughout India. India is blessed with sub continent climatic condition that favours the growth of sugarcane. The major problem in Sugarcane is Red rot disease caused by Collectotrichumfalcatum which is often called as of sugarcane. It is the most devastating disease which causes great loss to the farmers. cancer Drought also increases susceptibility to disease. This disease was characterized by discolouration of leaf, reddening of internal tissues with intermingled transverse white spot and development of black fruiting body (Acevruli) on the rind. It was controlled by many methods namely Chemical, cultural, botanicals, nanomaterials and so on. This article gives detail information about the control measures of red rot of sugarcane.*

Keywords: Sugarcane, red rot, reddening of tissues, acervuli, cultural, chemical and botanicals

I. INTRODUCTION

Saccharumofficinarum is an important commercial crop grown by the farmers for its valuable uses in an area of about 24.5 mha, with a production of 1850 million tons and a par productivity of about 75.5 t/ha. According to USDA, India stands in 2nd place among the sugarcane producing countries next to Brazil with an average cultivation area of 5 mha, with the peak production of about 500 million tons in 2022 with a productivity of about 69.1 t/ha from which about 35.9 million tons sugar is produced. India comes up with the production of about 19.98% sugarcane to the world. Similar to cultivation, India also stands high as the largest consumer of sugar by consuming more than 15.5 million tons of sugar, 2nd position in exporting countries by shipping about 10.9 million tons of sugar to other nations by earning a foreign currency of about Rs. 40000 crores.

In India it is cultivated in North in Uttar Pradesh, Maharashtra, Haryana and in South in Karnataka, Andhra Pradesh, Tamil Nadu. The tropical climate in Southern states is much favorable for the rise in sucrose content in sugarcane. Sugar industry in India is the 2nd largest agro processing sector next to textiles which involves cotton. By 2050, for the estimated population of about 1.65 billion people, an average of 51 million tons of white sugar should be produced from around 630 million tons of sugarcane. (Girivasan T.V *et al,*2022)However , the Red rot disease caused by *Collectotrichumfulcatum* remains nightmare for the farmers. It can be controlled by many methods namely cultural, chemical and biological methods but there are some constraints that prevents the control of red rot disease.

Etiology:

The form genus *Colletotrichum* belongs to the form family *Melanconiaceae* form order *Melanconiales* form class *Coclomycetes* sub division *Deuteromycotina* and division *Eumycota.* According to Sutton(1973) there are 11 species of*Colletotrichum.* Alexopoulos and Mims (1979) reported 1000 form species of *Colletotrichum* of which majority and them seem to be a symptom. There has been 21 species found(Baxter et al ,1985)

Symptoms

Collectotrichumfalcatum is a common species which is responsible for the red rot of sugarcane. This fungus mainly attacks stems and leaves of the sugarcane plant. The leaves of the upper portion of the plant becomes pale or dark red which ultimately droop down. The stem splits and many red coloured longitudinally streakes are formed on it. The red colour is mainly in the vascular bundles and often in the pith. At the severe infection the stem gets rotten, shrink at internodes and become dull in appearance. The pathogen attacks all the part above theground, but more especially the

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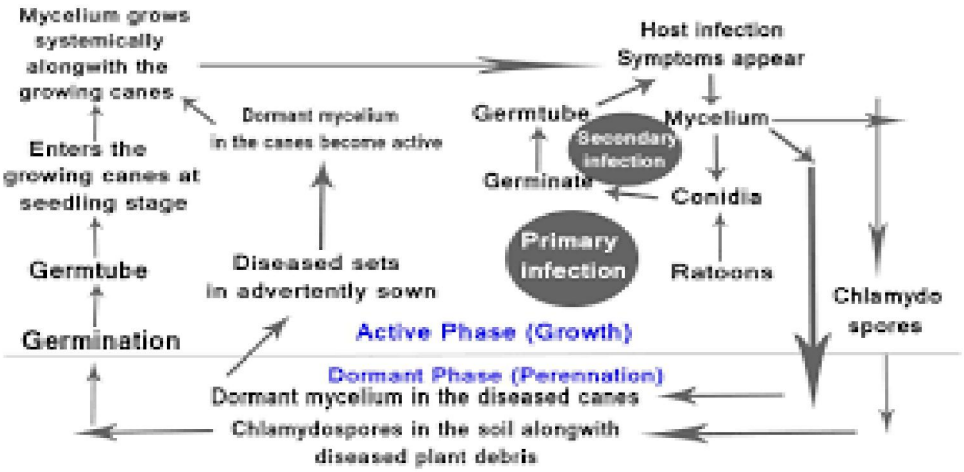
canes (stems) and midribs of leaves. In early stages disease is not recognisable in the field .First symptoms appear after the rainy season when the growth of plant stops and sucrose formation begins. Loss of colour and dropping of leaves(3rd or 4th from the top) are the earliest symptoms, gradually the entire tip withers. In later stages canes become shriveled, the rind sinks and become longitudinally wrinkled. When the diseased canes(stems) are splits open, the tissues of the internodes will be found longitudinally reddened (normally white or yellowish white) in one or more internodes. This red is interrupted by white patches extending crosswise on the canes. Incase of true red rot the red color extends through many internodes. Infection originates from the midrib of the leaves as a dark reddish area which elongates rapidly forming blood red lesions with dark margins. The cane extract (juice) often gives bad odor and does not set ell on boiling ,because of the conversion of the sucrose into glucose and alcohols by the actions of the enzymes of the pathogen. Late in the season dark colored (black), minute, velvety dots(acervuli of the fungus) are formed near about the nodes of the diseased canes and also in the sunken areas.

II. DISEASE CYCLE

The disease is chiefly seed borne and spread to the healthy crop through setts (i.e) sugarcane seeds taken from diseased cane. But the pathogen also present in soil in the form of conidia and chlamydospores like structure for a specific period. The conidia , after falling from the diseased cane may germinate in the soil and form appressoria which often act like chlamydospores. Sugarcane developed from the diseased sett are always diseased. If the healthy setts are planted in the field where viable conidia, chlamydospore like structure, viable mycelia etc. are present in the crop debris, then infection takes place through roots. Besides, ratooning of diseased crop is another effective method of survival and reoccurrence of disease. Conidia of the fungal pathogen are produced in the rind of the diseased cane, on midrib and the leaf blade surface of the leaf. On falling to the ground, they are disseminated by irrigation water and cause secondary infection. Dispersal of conidia also takes place by air, rainwater and insect. Buds and leaves of the healthy canes are infected by those conidia



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III. CONTROL MEASURES

3.1 Cultural Methods

The red rot pathogen also surives in the soil for many months in crop debris. Hence practicing of monoculture of sugarcane over a large area provide conditions faourable for rapid built up of inoculum. Crop rotation with paddy is recommended in tropical India, which in turn helps to reduce the debris borne inoculum of *Colletotrichumfalcatum.*

Growing of recommended resistant and moderately resistant varieties viz., Co 86032, Co 86249, CoSi 95071, CoG 93076, CoC 22, CoSi 6 and CoG 5. Opting for the good agricultural practices and integrating cultural and biologic control methods as a preventive measure should be of utmost priority. The use of healthy planting materials, certified seeds, field sanitation, crop rotation and proper drainage facility could significantly minimize red rot disease. These cultural practices have been suggested not only to reduce the inoculum from the field, but to also reduce crop losses. Mono cultivation of the same crop with the same cultivar increases the inoculum level resulting in the development of the disease. The crop must be rotated after two to three years/cycles in the heavily infested field and the ratooning should be discouraged [18]. Considering that red rot disease is seed/sett-borne, disease-free nursery should be adhered to [24]. Authorized enforcement of nursery programs is very important. Disease and pest free seeds/setts and mixtures with other varieties must be guaranteed. The most useful method for control of the pathogen is the use of disease-free setts.(MD Imam Hossain et al, 2020)

3.2 Chemical Treatments

A. Sett Treatment

To prevent sugarcane from seed-borne diseases and pests, make carbendazim slurry by mixing carbendazim 2 g / liter of water and chlorpyriphos 5 ml / liter and soak the setts in the prepared solution for 15 minutes.

B. Fungicides

Recent studies conducted at SBI revealed that sett treatment with systemic fungicide Thiophanate methyl@ 0.25%, Benomyl 50Wp and Randomyl 75WP (Muhammed Nasir Subhani *et al,2008)* are effective against debris borne inoculum of the pathogen in the soil. Subsequently, it was found that the combination of thiophanate methylate @0.05% + *Pseudomonas flourescenes*+ salicylic acid is also effective against the soil borne pathogen inoculum. Chlorothalonil was shown to have fully inhibited mycelia growth of test-fungus from five fungicides, accompanied by chlorothalonil (80.0%), whereas bayleton (75.71%) was less inhibitive.

3.3 Biological Control

The pyoluteorin producing bacteria *P. putida* strain NH□50 significantly reduced disease severity on both sugarcane varieties, irrespective of fungal inoculation, i.e. either inoculated through stem or through soil. This strain also possesses other plant growth characteristics and can be used as a biopesticide for sugarcane (Muhammad N Hassan *et al,*2011). Three strains of the genus *Bacillus* reduced disease incidence by 45-49% in sugarcane plants challenged by pathogen inoculation in the stem and by 48-56% in the plants inoculated in the soil near the roots.(MN Hassan *et al,*2012) red rot, fungal bioagents, viz. *Chaetomium*, *Trichoderma*, and bacterial antagonists individually For and in combination of bacterial antagonists and fungicide were found to be effective in protecting the crop. Capability of bacterial antagonists in inducing resistance through induced systemic resistance against red rot was established. Delivery of the antagonists through sett treatment was standardized for field application. Further, pressmud formulation of *Trichoderma* was found effective against wilt under field conditions.(Vijay singh ,2008)

3.4 Control Through Biochar

Soil amended with rice husk biochar @ 5% w/w changed in soil properties like pH, moisture content, particle density and bulk density. The inoculum density of *C. falcatum* was found suppressed in the soil amendment with rice husk biochar as contrast to unamended soil.(Delna Rose *et* al, 2022)

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3.5 Control Through Botanicals

Based on this premise the antifungal potency of *Azadirachtaindica*, *Lawsoniainermis* and *Khayasenegalensis* leaf extracts were tested on the mycelia growth of *Colletotrichumfalcatum*, the pathogen of red rot disease of sugarcane. The ethanol extract were prepared at different concentrations; 25%, 50%, 75% with distilled water and 0.5g/l cloth as the negative and positive control respectively. The prepared extracts and controls were tested for antifungal effects against *Colletotrichumfalcatum*.(JM Egubagi*et al,2019)*

3.6 Control Through Nanoparticles

The antifungal activity of AgNPs was also investigated for sugarcane fungal pathogens *Colletotrichumfalcatum*. All nanoparticles exhibit prominent antifungal activities . Best fungal inhibition was observed under application of sugarcane husk based AgNPs . Maximum zone of fungal inhibition was noticed about 18, 19, and 21 mm for *C. falcatum. (*Tariq Mahmood *et al 2021*).

IV. CONCLUSION

Although red rot is one of the oldest disease , it becomes a major problem in sugarcane farming community (Viswanathan& Samiyappan,2000) . Several measures have been adopted so far to control red rot it becomes virulent year after year due to many factors such as climate change, development of resistance and uncontrolled rationing. Researches have been showed that use of fungicides such as Benomyl50WP ,Radomyl 75WP and Folicar and regular crop rotation found to be most effective in disease control.

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