

## IV-L1

# CHANGING SCENARIO OF SUGARCANE DISEASES SINCE THE INTRODUCTION OF HYBRID CANE VARIETIES: PATH TRAVELLED FOR A CENTURY

**R. Viswanathan\***

*Head, Division of Crop Protection,  
ICAR-Sugarcane Breeding Institute, Coimbatore 641007  
\*rasaviswanathan@yahoo.co.in*

More than 50 diseases were recorded in sugarcane in sugarcane crop during different occasions. However, only a few diseases such as red rot, wilt, smut, yellow leaf disease (YLD), grassy shoot disease (GSD), leaf scald disease (LSD), ratoon stunting disease (RSD), rust and mosaic threatened sugarcane cultivation during different periods with varying intensities. Among these, researchers focused only on red rot on most of the occasions.

### **Red rot**

In India, serious outbreak of red rot was first observed during 1890s in the Madras Presidency on many noble cane varieties. Introduction of hybrid varieties in the country since 1918 had reduced red rot severity for a decade. However, elite varieties grown in the subtropical region succumbed to the disease one after another that resulted in severe epiphytotics in different decades after 1930s. This has resulted in a search for resistant sources among the parents and progenies, hence screening methods were developed for red rot resistance in sugarcane. Dr. B.L. Chona standardized plug method for disease screening. Subsequently, Dr. K.V. Srinivasan has developed a 0-9 rating scale and that has been accepted for disease rating and is being followed universally. Furthermore, to assess red rot resistance based on natural ways of pathogen entry, nodal methods were developed in different occasions. However, environmental factors played a crucial role in disease development and inconsistencies were found. The recently developed cotton swab method of ICAR- SBI has been consistent and adopted at all the AICRP centers in the country. Apart from field inoculation methods, a rapid controlled condition testing was developed at ICAR- SBI and is being followed to screen thousands of progenies every year at the Institute, thereby identifying red rot resistance at very early stages in varietal selection. During the past 100 years we witnessed series of red rot epidemics in the country and many elites varieties like Co 210, Co 312, Co 419, Co 421, Co 453, Co 658, Co 997, Co 1148, Co 6304, Co 7805, Co 89003, CoC 671, CoC 92061, CoJ 64, CoSi 86071, CoS 8436, CoSe 95422, CoSe 92423, CoLk 8102, CoV 09356, BO 11, BO 17, BO 54 etc., succumbed to the disease and new varieties were introduced to combat the disease in different decades and the disease onslaughts were reduced (Viswanathan, 2010).

Investigation on frequent breakdown of disease resistance in cane varieties to red rot established emergence of new pathotypes. The new pathotypes were found to be more virulent and the variant populations gradually adapted to the varieties in the field which resulted in the buildup of red rot in the varieties hitherto resistant; eventually, the pathogen succeeded by causing a 'varietal breakdown'. A set of host differentials were identified to establish pathogenic variation in designated pathotypes for different zones across the country. The designated pathotypes were recommended for disease screening for the respective zones. Recently studies were conducted to establish molecular variations in *C. falcatum* pathotypes/ isolates. However, the genetic variations could not be related to pathogenic variations which are observed under field conditions.



## **Smut**

Smut of sugarcane was reported for the first time during 1906 by Dr. E. J. Butler in India and since then the disease has been occurring in different states. Earlier, the disease has been a major constraint in Maharashtra and northern Karnataka when Co 740 was the major variety under cultivation. Large scale replacement of Co 740 with Co 86032 in the region reduced the disease severity significantly during the last two decades (Viswanathan, 2012). However, the large-scale adoption of the cv CoA 92081 (87A298) in Andhra Pradesh led to disease epidemics in the region on many varieties. Although the subtropical region has not witnessed severe smut in the recent decades, currently it occurs in many states at moderate or severe levels affecting the crop productivity. With robust screening for smut resistance in the varieties, the disease is managed successfully in the country.

## **Sugarcane wilt**

The disease was first reported during 1906 by Dr. E. J. Butler in the country and since then its occurrence has been reported throughout the country. Since it was reported that the disease occurs during maturity phase, the researchers and sugar industry personal ignored the disease in spite of severe damage witnessed in different decades. Any field under harvest exhibits 10-15% of dried canes and ~50% of them are due to wilt. The author has witnessed wilt from germination phase onwards in sugarcane. Both sett borne and soil borne pathogen contribute to disease occurrence during germination and in the young crop. Many varieties such as Co 245, Co 321, Co 419, Co 449, Co 453, Co 527, Co 951, Co 1107, Co 1122, Co 1223 and Co 89003 etc picked-up severe wilt in different regions during disease epidemics. Further, greater damage to cane varieties was recorded during combined infections of red rot and wilt. The variety CoC 671 suffered huge losses in Gujarat due to wilt in the 1980s and subsequently to wilt and red rot. Pathogen characterization has not been done for several decades and many pathogenic organisms were reported. However, detailed studies conducted at SBI very clearly revealed that only *Fusarium sacchari* is the causative organism based on the studies involving morphological characters, molecular profiles and pathogenicity of the isolates collected from different regions (Viswanathan et al., 2011). Recently, evidences have been found on the same pathogen causing wilt in stalk and pokkah boeng on the leaves in sugarcane. Under field conditions, managing the disease remains a serious challenge because of root and sett borne nature of the pathogen. Further, the disease severity is aggravated by many biotic and abiotic factors. Although resistance to wilt in sugarcane varieties is addressed, emphasis is not given as in the case of red rot and smut. Consequently, the disease causes serious loss to cane cultivation and sugar industry.

## **Grassy shoot**

Apart from the above three major fungal diseases, considerable research efforts were made on non-fungal diseases. Severe GSD was reported during the 1950s in Maharashtra and its spread and damage to sugar industry were realized later. Its severity in the field has led to initiation of healthy seed nursery programmes and heat therapy as a strategy to manage this phytoplasma disease was implemented in both tropical and subtropical regions. Aerated steam treatment developed by SBI and moist hot air treatment by IISR became popular to manage GSD and RSD. This measure reduced the disease severity and sugar industry has given considerable importance to nursery programmes.

## **Viral diseases**

Mosaic of sugarcane was reported way back in 1921 in the country by Dr. C. A. Barber. Yet, its impact was not realized inspite of its significant role in varietal degeneration. Importance of viral diseases was felt after the report of yellow leaf disease (YLD) by the author in the new millennium (Viswanathan, 2002). YLD along with mosaic causing viruses and RSD contributed in varietal degeneration in sugarcane (Viswanathan, 2016) and SBI has made remarkable progress in developing molecular diagnostics for different viruses/ phytoplasmas and proved that varietal degeneration can be effectively managed by virus elimination through tissue culture combined with molecular diagnosis. By this, varietal potential was restored in popular varieties like Co 86032 in the tropical region.

## **Current scenario**

In the recent years, apart from red rot, smut and wilt, the country witnessed serious epidemics of YLD, GSD, rust, pokkah boeng (PB) and brown spot in different regions. Among them, epidemics of YLD are very common. The emergence of rust, brown spot and PB is attributed to possible climate change scenarios and deployment of susceptible new varieties. Susceptibility to these diseases led to the withdrawal of elite varieties in specific regions. To address these disease constraints, efforts are being made to screen sugarcane varieties for YLD, rust and PB under AICRP. A 0-5 rating has been included in AICRP on sugarcane to identify YLD resistance in the varieties and a whorl method of inoculation has been standardized for rust screening.

## **Recent developments in disease management**

Adoption of disease resistant varieties is still considered the best option to manage the diseases in sugarcane in the past. This is considered environmentally safe and economically feasible. However, the major challenge is that an elite variety does not possess resistance to all the designated diseases. Hence, alternate disease management strategies were developed and being implemented successfully in the country. Seed nursery programme combined with heat treatment has been successful to manage GSD and RSD. However, the present recommendation of seed nursery programme has tissue culture combined with molecular diagnosis for viruses/ phytoplasma and it is highly beneficial to address all the non-fungal diseases in sugarcane including the dreaded YLD. Earlier fungicides were not recommended in sugarcane due to lack of efficient delivery methods. Recently, SBI has developed an efficient fungicide delivery through a sett treatment device. Such improved fungicide delivery through planting materials has prevented disease development from primary sources of red rot and smut inocula. Biocontrol approaches were also effective in managing red rot, wilt and other fungal diseases.

In the recent years, molecular tools have been applied in sugarcane pathology to characterize the pathogen and understand host-pathogen interactions. Complete genomes of important viruses such as SCYLV, SCMV, SCSMV, and SCBV were characterized from India. Prevalence of new variants, genotypes, species and genera in sugarcane viruses in India was reported. A new understanding has been established on host resistance in sugarcane to red rot and smut pathogens by using genomic, proteomic and transcriptomic tools. Complete genome and transcriptome of red rot pathogen were sequenced and studies are in progress to identify key pathogenicity genes.



## Epilogue

If we look back on the 100 years of research in sugarcane pathology, concerted efforts were made to identify resistance in germplasm and varieties to important diseases and to develop appropriate screening methodologies. This has benefited sustainable sugarcane cultivation in the country. Disease outbreaks were investigated in detail and new diseases were tackled in time. The scientific community has been benefited by the new understanding of host resistance, pathogen variation and diagnostics. The sugar industry is benefited from the virus-indexing service of the Institute to produce healthy planting material and sustain cane yield potential in commercial varieties.

## References

- Barber, C.A. 1921. *Intern. Sugar J.* 23: 12-19
- Butler, E. J. 1906. *Mem. Dept. Agri. India Bot. Ser.* 1 (3): 2-24.
- Srinivasan, K. V., and Bhat, N.R. 1961 *J. Indian Bot. Soc.* 40, 566-577.
- Viswanathan, R. 2002. *Sugar Cane Intern.* 20 (5): 17-23
- Viswanathan R. 2010, *Plant Disease: Red rot of Sugarcane*. Anmol Publications, New Delhi, 301p.
- Viswanathan R. 2012. *Sugarcane Diseases and Their Management*, ICAR-SBI, Coimbatore, p140.
- Viswanathan, R. 2016. *Sugar Tech* 18: 1-7
- Viswanathan, R. *et al.* 2011. *Sugar Tech* 13: 68-76.

