

Distribution Scenario of Major Diseases of Sugarcane in Andhra Pradesh, India

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Abstract

Sugarcane cultivation in India is hindered by several biotic constraints of which sett borne fungal and viral diseases play a major disaster. Of various fungal diseases, red rot (*Colletotrichum falcatum*) and smut (*Sporisorium scitamineum*) are major in sugarcane growing areas of Andhra Pradesh. Oflate, viral diseases of sugarcane such as mosaic (sugarcane mosaic virus, ScMV) and yellow leaf disease (YLD by Sugarcane yellow leaf virus (ScYLV)) are becoming major bottlenecks in sugarcane cultivation. Both these diseases are sett-borne. Being sett borne and vector transmitted, these viral diseases are assuming more severe form especially in Andhra Pradesh, where monoculture, ratooning and poor agronomic practices are in vogue. Our Present study is focused on understanding the prevalence of these sett borne fungal and viral diseases, varietal susceptibility major sugarcane growing areas of Andhra Pradesh, India. Our present study is focused on ascertaining the prevalence of these diseases, varietal susceptibility. Visakhapatnam, Vizianagaram, Srikakulam, East and West Godavari districts were surveyed during 2010-'16. Our survey results indicated that red rot was highest (68%) during 2012-'13 over other years. Highest incidence in this year was attributed to large scale cultivation of Co62175 (red rot susceptible). Further, decline in redrot after 2012-'13 is attributed to shift in cultivar selection to 87A298, 93A145 and 2003V46 (all red rot resistant). For smut, the disease incidence ranged from 36 to 56% and was highest during 2013-'14 (56%), followed by during 2011-'12 (52%). Uniformity in smut disease prevalence over years is attributed to the fact that farmers have been cultivating 87A298, a highly susceptible cultivar but resistant to redrot. YLD incidence steadily increased up to 2013-'14 (highest 78%) and declined thereafter (to 62%). There was a steady increase in mosaic disease from 2010-'11 (%) to 2016-'17 (41%). In general, at research fields of RARS, Anakapalle, cultivars such as 87A298, 2003V46 and Co86032 were found to be susceptible to both the viral diseases.

Keywords: Sugarcane; Sett Borne Diseases; Red Rot; Smut; Viral Diseases; YLD and Mosaic

Introduction

Sugarcane (*Saccharum officinarum* L.) is a major cash crop of India. The country ranks second in area and sixth in production worldwide, and thus earning a lot of revenue and supporting rural employment by various means. Biotic stresses are a major constraint to sugarcane production and of these; fungal and viral diseases are causing economically significant losses worldwide [1]. Of various viral diseases causing major destruction, sugarcane mosaic and yellow leaf diseases are major ones, causing devastating losses [2]. These viral diseases are more prevalent than before and are assuming as bottlenecks to sugarcane production in Coastal

Andhra Pradesh. A general increase in severity of these viral diseases along the transect of cane growing districts of Coastal Andhra Pradesh is attributed to monocultivation, increased rationing, poor agronomic and vector management strategies, besides farmers ignorance on the imminent losses due to virus infection in endemic areas. Since, both mosaic and YLD are transmitted through setts and aphids (*Melanaphis sacchari* and *Rhopalosiphum maydis*), the disease is more problematic in areas with poor vector management. Coupled with, both these viral diseases are sett borne and thus so, selection of setts from healthy canes is a pre-requisite for producing viral free canes under field conditions.

In Coastal Andhra Pradesh, sugarcane is being cultivated to an extent of 1.065 lac ha with an annual production of 73.14 lac tones annually. Among different districts, Visakhapatnam, Vizianagaram, Srikakulam, Krishna, East and West Godavari are the major areas with significant cane production annually. Recently, there has been a drastic decline in the production statistics of sugarcane including quality due to incidence of viral diseases [3,4]. Of both Mosaic and YLD, mosaic disease incidence was once a minor disease and is now assuming a major form. The other viral disease, YLD is first reported in Andhra Pradesh during 2006 at sugarcane research fields of Regional Agricultural Research Station, Anakapalle, and is now spreading at alarming levels to all cane growing areas of Coastal Andhra Pradesh [5]. Unfortunately, no reasonably resistant sources of germplasm among cultivars are available against these viral diseases.

For successful management of these sett borne fungal and viral diseases, understanding the prevalence and distribution of these viral diseases is a pre-requisite. For this, a comprehensive survey in the cane growing areas is mandatory. A critical insight on these aspects will enable to draw valid conclusions on the nature of spread of these diseases. This is because, of late, mixed infections of both YLD and Mosaic diseases are noticed across all the cane growing district and irrespective of the cultivar grown, that too both in plant as well as ratoon crop. In this context, understanding the cultivar susceptibility to each of the diseases assumes significance. Statistics in these areas are handy for plant virologists to come up with comprehensive management strategies for each of the diseases individually as well as combined through application of IDM strategies by incorporating field resistant/tolerant cultivars as a component. Against this backdrop, the present study was taken up with an objective of assessing the prevalence of sett borne fungal and viral diseases in sugarcane crop grown in Coastal Andhra Pradesh.

Materials and Methods

A survey was undertaken in Coastal Andhra Pradesh in selected districts such as Visakhapatnam, Vizianagaram, Srikakulam, and East Godavari districts from 2010-'11 to 2016-'17. Surveys were conducted thrice in a crop year in the selected districts. A total of 10 mandals were selected in each district and three villages from each mandal. Red rot, smut, YLD and Mosaic disease incidence were recorded from 10 selected plots in each village and the data were pooled to arrive at a mean disease incidence. Same villages were visited every year and proper care was ensured to visit the same farmers' fields every year from 2010-'11 through to 2016-

'17. The per cent disease incidence was calculated and the mandals were categorized as disease incidence percents as <10%; 11-16%; 17-23%; 24-37%; and 38-65% and above. Areas with mosaic incidence of 38-65% and above were categorized as high risk and sensitive areas and these areas were mapped using global positioning systems (GPS) properly recording the coordinates.

Cultivar susceptibility

In screening trials for incidence of viral diseases at Regional Agricultural Research Station, Anakapalle, the mean disease incidence (%) of Sugarcane YLD and Mosaic Diseases were enumerated based on visual observations annually. The cultivars that were selected for the present study were 87A298, 2003V46 and Co86032, and these cultivars are the popularly grown cultivars in Coastal Andhra Pradesh. Data on % disease incidence on these cultivars were recorded from 2010-'11 to 2016-'17.

Results

Our survey results indicated that red rot disease was highest (68%) during 2012-'13 when compared to other crop grown years in Coastal Andhra Pradesh, India. Highest red rot incidence during 2012-'13 is attributed to large scale cultivation of susceptible variety Co62175 in Coastal Andhra Pradesh that resulted in disease flare up. The after decline of 2012-'13 in red rot incidence in the surveyed areas is attributed to shift in cultivar selection from Co62175 to other redrot resistant varieties like 87A298, 93 A 145, and 2003 V 46. The disease was at its lowest during 2016-'17 (22%). In other years, the disease incidence ranged from 28 to 42%. For smut, the disease incidence ranged from 36 to 56% during survey periods. Smut incidence was highest during 2013-'14 (56%), followed by 2011-'12 (52%) and during 2012-'13 (48%). More or less uniformity in smut disease appearance without any extremities as in red rot in surveyed areas is attributed to the fact that farmers have been cultivating 87A298, which is highly susceptible to smut but highly resistant to red rot.

The incidence of Yellow leaf disease (YLD) from 2010 to 2016 indicated that the disease increased steadily up to 2013-'14 (highest, 78%) from 2010-'11 (22%), and thereafter declined up to 2015-'16 (62%). Further, during 2016-'17, the disease is on the rise up to 69%. Sugarcane mosaic disease has shown a steady increase in incidence over years from 2010-'11 (2%) to 2016-'17 (41%). Higher levels of YLD and sugarcane mosaic disease in Coastal AP is attributed to increased susceptibility of all cultivars in the surveyed areas.

Figure 1: Incidence of red rot and smut diseases of sugarcane in Coastal Andhra Pradesh, India during 2010 to 2017.

Figure 2: Incidence of yellow leaf disease (YLD) and Mosaic diseases of sugarcane in Coastal Andhra Pradesh, India during 2010 to 2017.

Figure 3: Mean Red rot and Smut incidence in different mandals of Visakhapatnam, Vizianagaram, Srikakulam, East Godavari districts of Andhra Pradesh, India during 2010-'17.

Risk and sensitive areas with respect to sugarcane diseases

Our 6 years survey results indicated the prevalence and severity of redrot, smut, mosaic, and YLD in Visakhapatnam, Vizianagaram, Srikakulam and East Godavari districts of Coastal Andhra Pradesh, India.

Redrot

In the surveyed mandals, red rot incidence was least (up to 12%) in Saluru and Gajapathinagaram (Vizianagaram district); Kapileswarapuram (East Godavari district). In other mandals, red rot incidence ranged from 13 to 67%. High risk areas with red rot incidences ranged from 38-65% includes Anakapalle, Chodavaram, Munagapaka, Kasimkota (Visakhapatnam district); Santakaviti, Burja, Ponduru, Sankili and Kaviti mandals (Srikakulam district). In East Godavari, the disease ranged from 13-18% (Figure 3).

Smut

In the surveyed mandals, smut incidence ranged from 22 to 51% (mean of six years data from 2010-2016). High risk and sensitive areas (45-51%) with respect to smut incidence was found in Munagapaka and Kasimkota (Visakhapatnam district). Disease incidence was lowest (22-28%) in Rolugunta, Yellamanchili (Visakhapatnam); Seethampeta, Santhakaviti, Burja (Srikakulam district); Annavaram, Peddapuram and Eleswaram mandals (East Godavari district). The rest of the mandals in different districts had smut incidence ranged from 29 to 44% (Figure 3).

Mosaic

In the surveyed mandals, mosaic disease incidence was least (11-16%) in Narsipatnam, Etikoppaka, Devarapally mandals (Visakhapatnam); Rajam, Salur, Jami, Ramabhadrapuram, Terlam, Bobbili, Merakamudi, Gajapathinagaram, Parvathipuram and Nemalam mandals (Vizianagaram); Sankili, Santhakaviti and Mandasa mandals (Srikakulam). High risk and sensitive areas (38-65%) in these districts include Munagapaka, Atchutapuram, Kasimkota and Anakapalli mandals (Visakhapatnam) (Figure 4).

Yellow Leaf Disease (YLD)

In the surveyed areas, YLD was less (0-28%) in Chodavaram, Rolugunta, Devarapalli, Kotavuratla, Nakkapalli and Payakaraopeta mandals (Visakhapatnam district); Rajam, Salur, Terlam, Gajapathinagaram, Kothavalasa, Ranasthalam and Nemalam (Vizianagaram district); Sankili, Santhakaviti and Mandasa (Srikakulam district); Tondangi mandal of East Godavari district. High risk and sensitive areas (55-85%) with respect to YLD in these surveyed districts include Munagapaka, Etikoppaka, Atchutapuram, Kasimkota, Ana-

kapalli mandals (Visakhapatnam district); Kapileswarapuram, Chelluru, Kadiyam, Korukonda mandals (East Godavari district). For rest of the mandals in each of the surveyed districts, the YLD incidence ranged from 29-54% (Figure 4).

Figure 4: Mean Mosaic and YLD incidence in different mandals of Visakhapatnam, Vizianagaram, Srikakulam, East Godavari districts of Andhra Pradesh, India during 2010-'17.

Cultivar susceptibility to sugarcane viral diseases

Further, our studies at experimental fields of Regional Agricultural Research Station, Anakapalle indicated that all the popularly grown sugarcane cultivars such as 87A298, 2003V46 and Co86032 have shown increased susceptibility in general over years from 2010-'11 through to 2016-'17. As a slight exception to this, marginal decrease in mosaic incidence was noticed on the cultivar, 87A298 in 2012-'13 (10%) when compared to during 2011-'12 (12%) (Figure 3). Highest incidence of mosaic disease (36% in 87A298; 38% in 2003V46; and 46% in Co86032) was recorded on all the three cultivars during 2016-'17. Overall, our results suggest that all the three sugarcane cultivars under study were found susceptible to mosaic disease over due course.

On the other hand, irrespective of cultivars, YLD has shown no preference in cultivars and is rampant as years progressed.

Discussion and Conclusions

Our studies indicated the prevalence of Sugarcane sett borne fungal and viral Diseases in Coastal Andhra Pradesh. Further, popularly grown cultivars of Coastal Andhra Pradesh are being prone over time to these viral diseases, thus indicating the need to act swiftly in devising plant protection tactics comprehensively to viral diseases. In the surveyed districts, there was an increase in both YLD and Mosaic over time. Significant number of hot spot areas in each of the surveyed districts are of concern (Figure 2). Steady increase in these disease from 2010-'11 to 2016-'17 over years

(Figure 2) is majorly attributed to poor vector management and rationing of mosaic diseased crop. Earlier reports also established the relationship between high mosaic disease with use of diseased seed material, monocropping, and increased number of rationing and poor vector management [6]. In particular, aphids play a significant role in spread of virus diseases of sugarcane, thereby causing huge economic losses [7]. Proper care hence must be taken to educate the farmers on disease progression through various factors and on the ambient climatic conditions that prevail for taking up the prophylactic measures to overcome the same.

In our studies, all the popularly grown cultivars have shown susceptibility over time from 2010-'11 to 2016-'17 to mosaic incidence (Figure 3). Increased susceptibility of CVs: 87A298, 2003V46 and Co86032 over time to mosaic disease is also majorly attributed to increased number of rations, use of diseased seed material and poor vector management. Our vector transmission studies have established the presence of virus particles in aphids collected from diseased plants/fields. Previously, researchers have established that proper vector management in conjunction with other virus management strategies can significantly bring down mosaic and other viral disease incidences in sugarcane [7]. It is precisely at this juncture, the role of Integrated Disease Management of viral diseases assumes significance.

Farmers' awareness on these viral diseases is however poor and is of major concern. In particular, majority of farmers are ignorant of these viral infections in their sugarcane fields. They largely attributed the symptomatology of these viral diseases as manifestation of sugarcane decline due to unknown reasons. However, few farmers (<1%) opined and attributed that unhealthy seed as source of these viral diseases. Majority of farmers are also not aware of vector transmission of these two viral diseases. In our surveyed areas, over time, there has been combined infections of both Mosaic and YLD during earlier years (2011-'12). As years progressed, the mixed infections of both these viral diseases are prominent on a single plant. This is also true with individual leaves, wherein leaves have mixed infections of both these viral diseases in particular during 2016-'17 [8-10].

Our future studies are therefore directed to devise comprehensive Integrated Management strategies for sett borne fungal and viral diseases of sugarcane in general through following IDM practices proper and timely vector management, along with bringing up awareness to farmers on the precise use of healthy seed, avoiding mono-cropping and more rationing.

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