

DISEASE STATUS OF SUGARCANE IN UTTAR PRADESH

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Abstract: Sugarcane is an important cash crop grown in tropical and subtropical part of India. A popular wonder farmer liking sugarcane variety Co 0238 covering 86.7 per cent during 2020-21 and plays a major role to increase sugar recovery and sugarcane productivity since last several years in Uttar Pradesh (UP). Sugarcane growers and industries are facing many problems of red rot, smut, wilt and pokkah boeng incidence in UP. Extensive survey of sugarcane growing areas of UP was conducted during last five consecutive years from 2015-16 to 2020-21. Red rot travelled a six year journey from 2015-16 to 2020-21 in UP and devastated particularly in different districts of central and north of UP. Severe incidence of red rot on Co 0238 was succumbed up to dried out (70-100% Incidence) condition at several districts of central UP. Mix infection of red rot and wilt was also accessed up to 30 per cent on Co 0238. The total red rot infected area in UP was observed 24000 hectare of 44 cane producing districts in the year of 2019-20 while 22064.38 hectare area of 45 cane producing districts in 2020-21. Smut and wilt was assessed in several varieties up to 10% and 90% incidence, respectively. Other diseases such as grassy shoot disease, pokkah boeng, red strip/top rot (Bacterial), mosaic (SCMV), leaf scald, yellow leaf disease and leaf fleck were also noticed up to various extend in some varieties at different sugar factories area of central UP. Therefore, this survey work could be fruitful to confirm the diseases in exceedingly occupied areas of UP. Farmer could aware to manage red rot in own particular area. They could be implemented integrated disease management steps for the prevention of this disease prone area.

Keyword: Disease, incidence, red rot, sugarcane, sugar mill.

INTRODUCTION

Sugarcane is one of the important cash crops in India and plays important role in both agricultural and industrial economy of tropical and subtropical part of our country. Sugarcane variety derived from various crosses based on their ability to produce high sugar yield and resistance to red rot. The genetic consistency generated not only done by inter-specific hybridization but also back crossing of major poly, bi-parental and general crosses for the sustaining of disease resistance and sugar quality [2]. The back cross of hybrids to *S. officinarum* resulted in high sugar yield and red rot and other disease resistance in nobilization

process [12]. Although, the nobilization is highly successful but due to limits of the resistant gene pool in selected parents which exploited during traditional breeding programmes, very limited progress has been achieved in increasing red rot resistant progenies with high sugar content and yield [6, 18]. The several diseases are critical in nature to reduce the production and productivity of sugarcane. The different 240 diseases of crop are reported from the initial stage of planting to harvest [13]. About fifty five diseases of sugarcane caused by various microbes such as fungi, bacteria, viruses, phytoplasmas and nematodes have been reported from India [11]. About 10-15 per cent of the nation sugar produced

is lost due to the diseases [22]. In sub-tropical India, UP Council of Sugarcane Research was set up in 1912 and centurial contribution by this organization; plays a major role in development of more than 200 red rot resistant varieties in Uttar Pradesh region. Several varieties were out of cultivation due to varietal breakdown by red rot and varietal degeneration due to different non-fungal pathogens [21]. Sugarcane growers and industries are facing many problems of red rot incidence in Uttar Pradesh (UP). Extensive survey of sugarcane growing areas of Uttar Pradesh was conducted during last five consecutive years from 2015-16 to 2020-21.

MATERIALS AND METHODS

An extensive survey of sugarcane growing areas of Uttar Pradesh was conducted during last five consecutive years from 2015-16 to 2020-21 during pre-monsoon (May-June) and post-monsoon (October-November). Plot wise assessment was carried out in Cooperative sugar mills such as Bisalpur, Poowayan, Tilhar and private sugar mills namely Ajbapur, Hariyawan, Kumbhi, Gularia, Khambarkheda, Loni, Faridpur, Nigohi, Aira, Nawabganj, Palia, Pilibhit, Ramgarh, Jawaharpur, Biswan, Rupapur, Gola, Rosa, and Hargaon sugar mill areas. About 400 to 500 acre sugarcane field were surveyed in each sugar mill area. Incidence of diseases was computed on clump basis. Several sugarcane diseases such as red rot, smut, wilt, grassy shoot disease, pokkah boeng, red strip/top rot (Bacterial), mosaic (SCMV), leaf scald, yellow leaf disease and leaf fleck were observed during survey work.

RESULTS AND DISCUSSION

Red rot

Red rot is the most common disease of sugarcane, caused by the fungus *Colletotrichum falcatum* Went and also called as cancer of sugarcane. It causes severe loss in yield and quality of the susceptible cultivars in the Indian sub-continent. The march of red rot is being take over soon in a large area in various districts of UP and could create a havoc condition. A vegetatively propagated crop like sugarcane needs a long time, more seed quantity to multiply a variety and heavy investment

by the factory and farmers. Replacement of an existing popular variety Co 0238 with a suitable alternative is a difficult task due to prompt need of more seed cane and heavy investment, but it is a real prevention of red rot under field conditions [5]. The first external and visible symptom appears on stalk at the progressive grand growth stage after adequate stalk formation takes place. This starts with the yellowing of one or two leaves of the top, yellowing as well as withering of leaves starts from the margin. It initiates the yellowing of third or fourth open leaves and turns orange yellow in colour. Later on, the entire top becomes light orange yellowish and dies. The stalk may sometimes show reddish to purplish discoloration of the rind. Diagnostic symptoms can only be observed by splitting the stalk length wise, the typical red rot symptoms become visible in the internodal tissues. Reddening of the internal tissues interspersed with white spots, which are usually at right angles to the long axis of the stalk [5].

A popular wonder early maturing sugarcane variety Co 0238 covering 86.7 per cent during 2020-21 and plays a major role to increase sugar recovery and sugarcane productivity since last several years in Uttar Pradesh (UP). This variety was covered 19.80 per cent area in 2015-16 but it multiplied rapidly due to farmer liking and spreaded up to 86.67 per cent in 2020-21. Sugarcane growers and industries are facing many problems of red rot incidence in Uttar Pradesh (UP). Red rot travelled a six year journey from 2015-16 to 2020-21 in UP and devastated particularly in different districts of central and north of UP state. The journey of red rot was initiated from 5 to 100 per cent in variety Co 0238 during 2015-16 and 2020-21, respectively. The primary source of this disease was spreaded very fast by infected soil as well as setts at farmer fields. Severe incidence of red rot on Co 0238 was succumbed up to dried out (70-100% Incidence) condition at Ajbapur, Hariyawan, Kumbhi, Gularia, Khambarkheda, Loni, Faridpur, Nigohi, Bisalpur and Hargaon sugar mill areas (Plot wise assessment) (Fig 1, 2). Several districts of central Uttar Pradesh were found more affected by red rot on Co 0238 Combine infection of red rot and wilt was also

noticed from 15 (CoPk 05191) to 75 per cent (Co 0238). The total red rot infected area in UP was observed 24000 hectare of 44 cane producing districts in the year of 2019-20 and 22064.38 hectare area of 45 cane producing districts in 2020-21. Severe incidence of red rot up to dried out condition was recorded in 16 districts such as Lakhimpur, Sitapur, Balrampur, Gonda, Kushinagar, Bareilly, Bahraich, Deoria, Hardoi, Shahjahanpur, Basti, Azamgarh, Ayodhya,

Ambedkarnagar, Maharajganj, Bijnor of UP. Maximum red was reported in top six district such as Lakhimpur (8479 hectare area), Sitapur (2834.60 ha), Balrampur (1760 ha), Gonda (1257 ha), Kushinagar (1200 ha) and Bareilly (1000 ha) in 2020-21 (Table 1). Apart from Co 0238, other varieties such as CoJ 85, CoJ 88, CoPk 05191, CoS 08279, CoS 97264 and CoS 8436 were also affected with red rot up to two percent at Palia, Hariyawan and Biswan sugar mill area.



Figure 1: Red rot affected sugarcane crop of Co 0238 and severe foliage drying at Nigohi sugar mill area



Figure 2: Reddening of the internal tissues with white spot and cavity formation

Table 1: Districts wise red rot affected area in UP state (2020-21)*

Sl. No.	Name of Districts	Red rot affected area in ha
1	Lakhimpur	8479.00
2	Sitapur	2834.60
3	Balrampur	1760.00
4	Gonda	1257.00
5	Kushinagar	1200.00
6	Bareilly	1000.96
7	Bahraich	960.00
8	Deoria	945.00
9	Hardoi	857.90
10	Shahjahanpur	775.89
11	Basti	467.25
12	Azamgarh	411.00
13	Ayodhya	403.76
14	Ambedkar Nagar	290.00
15	Maharaj Ganj	132.00
16	Bijnor	125.79
17	Gorakhpur	73.00
18	Barabanki	45.61
19	Muradabad	31.66
20	Sultanpur	13.50
21	Sambhal	0.46
-	Total area	22064.38

*Data source: Sugar Industry & Cane Development Department, UP.

Smut

Smut of sugarcane is caused by the fungus *Sporisorium scitamineum* (Syn. *Ustilago scitaminea*) [19]. The first report of the disease incidence came from Natal, South Africa in 1877 as reported by [7] and it was speculated to be confined in the eastern hemisphere, until it was reported in Argentina. The most recognizable diagnostic

feature of sugarcane infected with smut is the emergence of a long, elongated whip. The whip morphology differs from short to long, twisted, multiple whips etc.. Affected sugarcane plants may tiller profusely with spindly and more erect shoots with small narrow leaves with poor cane formation.

Smut was assessed in several varieties namely Co 0238, Co 0118, CoH 160, Co 98014, UP 05125 and CoS 13231 up to 10 to 30 per cent incidence level. Maximum incidence up to 50 per cent of this disease was reported on CoS 07250 and CoSe 01434 from Rosa (Shahjahanpur) factory zones during 2017-2018. Co 0238, Co 1158, CoS 98231, CoS 767, CoSe 92423 and CoLk 94184 at Hardoi, Gajraula, Palia and Shahjahanpur, it was also reported on CoJ 88 which was severely affected with smut at Deoband (Saharanpur) factory zone during 2016-17 (Fig 3 C).

Wilt

Wilt is one of the early known diseases of sugarcane in India. Although first reported by Butler [3] from Bihar, detailed studies were made a few years later by Butler and Khan [4]. Wilt is a serious constraint to sugarcane production in India and is next to red rot caused by *Colletotrichum falcatum* in terms of economic losses. *Fusarium sacchari* was identified as the causal organism based on detailed morphological features and molecular characteristics and this has resolved conflicting claims regarding the true causal organism as species of *Fusarium*, *Cephalosporium* and *Acremonium* [24].



Figure 3. Diseases symptoms. A, B: Wilt, C: Smut.

Wilt disease were reported on varieties Co 05011, Co 0238, CoS 08279, CoS 08272, CoS 08276 and CoS 08452 from Sugarcane Research Institute (SRI), Shahjahanpur, its incidence varied from 0.1 to 12 percent. This disease was also observed on Co 05011 and CoS 8432 with incidence varied from 0.2 to 25 per cent at Sitapur and Lakhimpur Kheri, Sugarcane Research Centre, Golagokaranath, Shamli and Mawana. Wide range of wilt incidence observed from 1 to 90 per cent on variety Co 0238 from Shahjahanpur, Lakhimpur, and Hardoi districts (Fig 3 A, B).

Grassy shoot disease

Sugarcane (*Saccharum* spp. hybrids) is affected by two lethal phytoplasmal diseases, i.e., Sugarcane grassy shoot (SCGS) and Sugarcane white leaf (SCWL) [10]. SCGS disease has been reported to occur in India, Bangladesh, Malaysia, Nepal and Pakistan whereas SCWL is predominant in Taiwan, Sri Lanka and Thailand [11].

Grassy shoot disease was observed on various popular varieties in farmer's field at Shahjahanpur, Hardoi, Sitapur and Lakhmpur Kheri districts. Grassy shoot disease was observed on Co 0238, Co 0118, Co 98014, CoS 08279, CoS 13231, CoSe 11453, CoS 09232 and CoLk 94184, ranging from 1 to 50 per cent at Shahjahanpur, Hardoi, Pilibhit, Sitapur and Lakhimpur Kheri districts (Fig 4).



Figure 4: Disease symptom of grassy shoot disease

Pokkah boeng disease

Sugarcane yield losses recorded up to 40 per cent after incidence of pokkah boeng. Severe incidence has been reported earlier in Yunnan, China and Shahjahanpur [15, 20]. The major characteristic symptoms manifest as chlorosis, twisting and shortening of young leaves as well as stalk rot. Many Various *Fusarium* species such as *F. moniliformae*, *F. sacchari*, *F. verticillioides* and *F. moniliforme* var. *subglutinans* causes pokkah boeng disease [20, 8, 16, 23]. Pokkah boeng incidence observed in major sugarcane growing states namely Uttar Pradesh, Uttarakhand, Maharashtra, Karnataka, Andhra Pradesh, Punjab, Haryana, Rajasthan, Assam, Tamil Nadu and Bihar in India [1].

The incidence of pokkah boeng varied from one to 60 per cent on Co 0238 at various sugar factories area. Knife cut stage of pokkah boeng was recorded on Co 0238 and CoS 08279 at Shahjahanpur, Hardoi, Kheri and Pilibhit districts. Similarly, other varieties namely CoS 08272, CoS 08279, CoS 08452, CoS 09232, Co 0118, Co 98014, and CoLk 94184 were found affected by this disease in Rosa (Shahjahanpur), Sitapur, Gajraula, Palia and Gola factory zones (Fig 5 A, B).

Pokkah boeng has been correlated with climatic conditions. Pokkah boeng incidence appeared during Ist fortnight of June and gradually increased till July to September due to high rainfall and humidity. Rainfall in July, August and September were recorded 484.6 mm, 140.6 mm and 167.2 mm, respectively. Likewise, utmost relative humidity was recorded up to 82%, 81% and 84% in same months, respectively. Higher relative humidity percentage coupled with cloudy weather and showery favoured to the growth of pathogen. Maximum temperature also recorded as 33.5°C, 33.5°C and 32.3°C in aforesaid months, respectively. Temperature, rainfall and relative humidity collectively played a key role in the severe incidence and spreading of PB (Table 2). Pokkah boeng was favoured by warm, moist condition with typical symptoms develop during the monsoon season which coincides with rapid and vigorous growth phase of the crop, additionally summer showers with cloudy weather also favour disease development. Three to seven months old crops are most susceptible to the disease [20].



Figure 5. Diseases symptoms of pokkah boeng ; A- Foliage symptom, B-Knife cut symptom

Table 2: Climatic conditions of Sugarcane Research Institute, Shahjahanpur from April, 2019 to March, 2020

Sl. No.	Month	Rain fall (mm)	Temperature (°C)		Relative humidity % (Mean)
			Maximum	Minimum	
1	April, 2019	6.4	36.4	21.4	47
2	May, 2019	2.6	39.9	24.7	34
3	June, 2019	53.0	38.7	27.0	54
4	July, 2019	484.6	33.5	26.3	82
5	August, 2019	140	33.5	26.4	81
6	September, 2019	167.2	32.3	25.5	84
7	October, 2019	-	31.3	19.9	73
8	November, 2019	12.0	28.4	14.9	76
9	December, 2019	82.2	18.8	8.9	80
10	January, 2020	28.0	18.9	9.0	82
11	February, 2020	12.0	23.8	9.9	68
12	March, 2020	59.0	28.4	15.5	68

Yellow leaf disease

Sugarcane yellow leaf disease (YLD) is one of the most prevalent disease of sugarcane worldwide. This disease is caused by sugarcane yellow leaf phytoplasma (SCYLP), a specific 16SrXII group of phytoplasma associated with this disease and also caused by Sugarcane yellow leaf virus (SCYLV; Luteovirus) in India. Sugarcane yellow leaf virus (SCYLV) belonging to the genus Polerovirus, family Luteoviridae, causes yellow leaf disease in sugarcane. YLD was first reported in Hawaii during 1988 [14] and in India during

1999 [9]. Usually the characteristic symptoms of YLD appear during 6–8 months crop age and last till maturity phase of the crop. The symptoms of YLD appeared as a distinct yellowing of leaves spreading laterally from the midrib into the lamina, and leaves begin to die from the tip [17]. The incidence of YLD varied from 1 - 30 per cent on several popular cultivars such as Co 0238, CoS 09232, CoS 08272, CoS 08279, CoS 12232, CoS 13231, UP 05125, Co 0118, Co 98014 and CoS 08276 at SRI, Shahjahanpur, Sultanpur, Faizabad Balrampur districts and in different districts (Fig 6).



Figure 6: Crop deterioration due to incidence of yellow leaf disease.

Other minor diseases

Sugarcane bacilliform virus (SCBV) causing leaf fleck was observed on the various newly promising genotypes such as Co 14034, CoLk 14201, CoLk 14204, CoLk 16201. It was also found on Co 0238 and Co 98014 in Shahjahanpur district (Fig 7 C). Several other diseases such as red strip/top rot (Bacterial), mosaic (SCMV) (Fig 7 A, B), leaf scald, ring spot and banded sclerotial were also noticed up to various extend

in some varieties at different sugar factories area of central UP. The incidence of leaf binding was reported on varieties CoS 08272, CoS Co 0118 and Co 0238 in trance at SRI Shahjahanpur. Physiological disorder such as stem gall and banded chlorosis were also noticed on varieties Co 0238, CoS 08279, respectively.

Therefore, this survey work could be fruitful to confirm the red rot in exceedingly occupied areas of Co 0238. Farmer could aware to manage

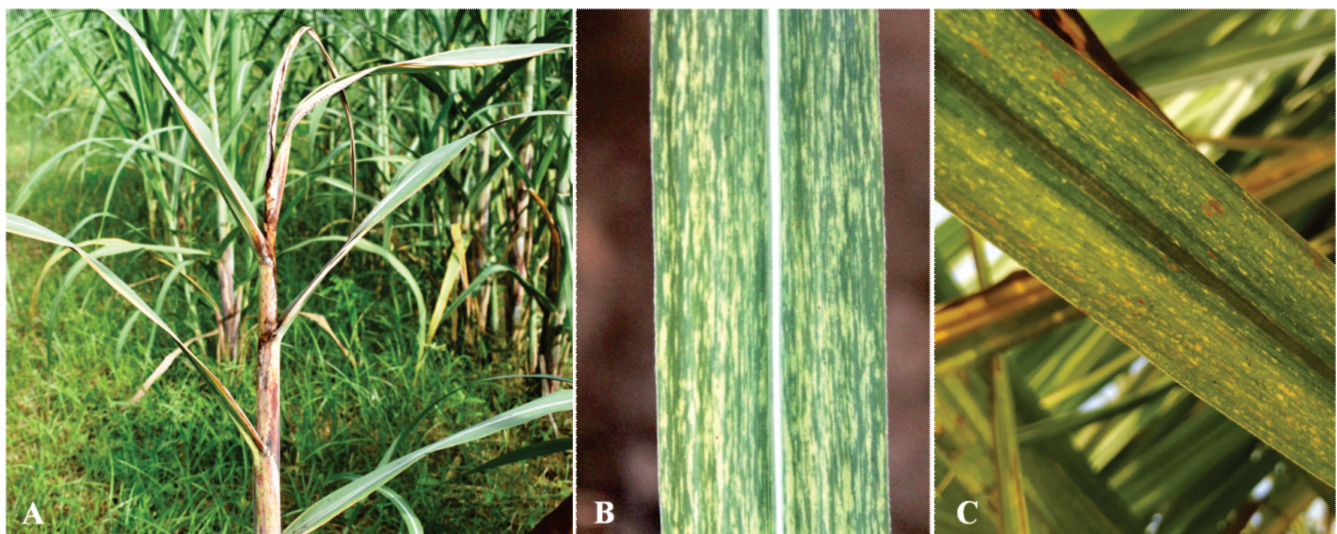


Figure 7: Disease symptom. A: Top rot (Bacterial), B: SCMV, C: SCBV.

red rot in own particular area. They could be implemented varietal replacement, healthy seed production crop rotation, avoid mono culturing, varietal diversity, soil sanitization, clean cultivation for the prevention of this disease prone area.

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