



INCIDENCE OF RED ROT DISEASE IN SUGARCANE VARIETY, CoS 8436, IN BIHAR, INDIA

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Abstract

Red rot infection is a severe fungal infection which causes huge damage to crop once invaded, especially, during the monsoon seen when this pathogen finds favorable condition. Assessment of incidence of red rot infection in sugarcane varieties is an important matter to be looked at as this infection has led to downfall of several varieties such as CoJ 64, CoJ 82, etc., for commercial use. Thus, the study aimed to check the incidence of red rot disease in sugarcane variety, CoS 8436, in farmer field of Bihar, especially during flooding season. Results showed that although CoS 8436 is a good yielding variety of Bihar but incidence of red rot infection caused loss of 30664 q and 147084 q in cane production in the year, 2016-17, when the infection occurred and in the subsequent year, 2017-18, respectively. Also, productivity was lowered in both the years (86 q/ha) and 456 (q/ha) in 2016-17 and 2017-18, respectively, in comparison to the year when there was no incidence of red rot in this variety. Furthermore, cane area was also reduced after the red rot infection was revealed. Scaling data revealed that when the floods arrived in Bihar, red rot infection in this variety was moderately susceptible but aftermath of floods causes this variety to be susceptible to this infection.

Key words : Red rot, sugarcane, CoS 8436, cane production, productivity.

Introduction

Sugarcane is cultivated in most of the states of India and had total area coverage of 4669,000 ha hectare as per 2017-18 reports (Anonymous, 2018). In Bihar as per recent reports (first advance estimate for 2017-18), sugarcane covers an area of 247,000 ha having a cane production of 14269,000 tonnes with a cane yield of 57.8 t/ha (Anonymous, 2018). It is the second most important agro-industrial crop in India, next only to cotton. India stands second in position in world's cane productivity ranking after Brazil, where losses due to relatively higher bacterial/fungal infections in canes may be the reason behind its low productivity. Jayshree *et al.* (2010) had revealed that in India, the estimated loss in crop production due to fungal diseases is about 18-31%. Invasion of bacterial or fungal infections leading to emergence of several diseases in sugarcane is a concern problem causing severe losses in sugar recovery and yield (Satyavir, 2003).

Red rot of sugarcane, caused by *Colletotrichum falcatum* Went, is a serious fungal disease affecting sugarcane stalks, the economical part of sugarcane. The enormous damage potential of red rot disease is reflected from even the first documented epidemic in 1895-1900 in the Godavari delta of India where it pushed sugarcane cultivation to the brink of extinction. Mature cane stalks and leaf mid ribs are the infectious sites where this disease is predominantly be seen. This disease is known to be transmitted through infected setts used as planting material, diseased stubble for ratoon purpose and resting of its propagules in the soil which causes severe harm to crop in terms of production, productivity and yield (Satyavir, 2003). Studies have shown that there is higher probability of annual reoccurrence of this disease in sugarcane as pathogens could be passed on to the next crop with the usage of infected seed canes and stubble as stated earlier (Pandey and Shukla, 2017; Neelofar and Kumar, 2017). The invasion of this pathogen begins from

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the initial stage of growth, i.e., germination (Agnihotri, 1996) leading to failure in germination or death of seedlings. In general, dormant mycelia present in the bud scales are responsible for post-germination infection of young emerging shoots (Viswanathan *et al.*, 2011).

Various factors such as nature of infection, time of season and weather conditions are responsible for red rot infection in sugarcane (Singh, 2008). Studies have reported that this infection finds favorable conditions when mean temperature ranges between 29.4 to 31°C (Singh *et al.*, 1988; Beniwal and Satyavir, 1991) having pH of 5-6 with high humidity. Also, cane areas having frequent exposure to drought and water logging conditions have been reported to be more prone to such infection in canes. Besides, lack of proper cultural practices, continuous usage of same variety in same field and presence of susceptible varieties nearby are some of the other factors that play role in favorable red rot infection. Sugarcane stalks are infected with pathogen through nodes and main portal of entry are leaf scar, growth ring, root primordia and buds (Steib and Chilton, 1951; Singh *et al.*, 1983). Another way of entry of this infection into the cane stalks occurs *via* rootlets, growth cracks or through cut ends of the setts. Once the fungus invades cane stalk tissues, the mycelium may spread from cell to cell which results in formation of gum, particularly in moderately resistant genotypes. Occurrence of infection through vascular bundles takes speedy pace in spreading through the cane stalks (Beniwal and Satyavir, 1991).

In India, this disease has been a menace for sugarcane cultivation and many elite varieties were removed from cultivation due to their susceptibility to this disease. Singh (2008) and Babu *et al.* (2010) had showed this disease causes severe loss in yield and quality of the susceptible cultivars in the Indian sub-continent and can reduce cane weight up to 29 % along with loss in sugar recovery by 31% (Hussnain, 2006). Viswanathan (Viswanathan *et al.*, 2011) had revealed that this disease had infected several varieties of Uttar Pradesh leading to threat for usage as commercial crop such as CoJ 64, CoPant 84211, etc. Incidence of red rot disease had also been reported in cane varieties grown in Bihar (Singh *et al.*, 2000; Anonymous, 2006). Duttamajumder (2008) had revealed that the disease, under epiphytotic conditions, may lead to total crop failure. In sub-tropical India, this disease had caused a serious issue in the states of Uttar Pradesh and Bihar during 1938–1939 and again in 1946–1947. This diseases was the reason behind the failure of immensely popular hybrid variety Co 213 leading to huge losses to sugar industries of this area. Besides the nature of the pathogen has been known to be variable which

could even causes resistant cane varieties to be susceptible ones (Kaur *et al.*, 2014; Sharma and Tamta, 2015; Singh *et al.*, 2017). Therefore in this context, the study was aimed to check the incidence of red rot disease in sugarcane variety, CoS 8436, in farmer field of Bihar.

Materials and Methods

The study was conducted at Farmers Field, West Chamaparan, Bihar in the year 2016-17 and 2017-18. CoS 8436, renowned early ripening variety of Bihar, covering an area of greater than 200 ha and have yield of more than 130000 quintals. Planting of cane variety, CoS 8436 was performed in month of February and March. Proper cultural practices were followed for high production and yield. Setts used for planting were healthy and were devoid of any previous history of infection. Routine assessment of sugarcane growth in CoS 8436 was performed in the farmers field in both the years. Symptoms of disease were recorded before and after monsoon in CoS 8436 in 2016-17 after which the area and variety was marked for the next year assessment. Canes showing doubtful symptoms were longitudinally cut to check the infection. Scaling of red rot infection was based as per the following table:

00	2.0	Resistant (R)
2.1	4.0	Moderately resistant (MR)
4.0	6.0	Moderately susceptible (MS)
6.1	8.0	Susceptible (S)
>8.0	9.0	Highly Susceptible (HS)

Cane yield, production and productivity were recorded in both the years to assess the loss in it.

Results and Discussion

Drying of sugarcane variety, CoS 8436, was observed before the onset of rainfall although proper cultural practices were followed. After the monsoon, top portion of CoS 8436 showed complete drying which indicates it to be some sort of infectious attack. Later diagnostic symptoms were seen in the leaves and stalks of sugarcane implying that there might be the infection of red rot in cane stalks (fig. 1). Similar results were also observed in Agnihotri and Singh (1977) and Singh and Singh (1989), which showed that symptoms of disease begins before monsoon appear, however, this becomes more prominent after the onset of monsoon, when conditions were favorable (Agnihotri and Singh, 1977; Singh and Singh, 1989; Singh, 2008). Literature supported the fact that preliminary symptoms of the infection were observed after the vegetative growth phase of the sugarcane had passed away and process of sucrose formation was



Fig. 1 : Field infected with red rot infection.



Fig. 2 : Longitudinal section of sugarcane stalk infected with red rot having white patches.

initiated (Duttamajumdar, 2008; Sharma and Tamta, 2015).

Leaves discoloration was the foremost symptom observed in the farmer’s field which indicated that it might be the infection of red rot in canes along with drying of the spindle leaves (3rd and 4th leaf). Occurrence of tiny reddish lesion having minute spots in red color on the leaf lamina was observed. Infection also resulted in change in the colour of the leaves that become straw colored in the center and dark reddish brown at the margins with the development of black acervuli. The infected leaves may break at the lesions and hang down. Similar results have been displayed by Viswanathan *et al.* (2008). Duttamanjumdar (2008) had also showed that under this infection alteration in coloration of leaves from the centre appeared. Dark reddish brown spots were also seen under such a case along with growth of black acervuli.

Longitudinal section of cane stalks showed the typical symptoms of red rot (fig. 2). Reddening of internal tissues

Table 1 : Scaling of samples of red rot infection in cane at farmers field, Bihar.

Sample No.	CT(0,1)		NT(1,2,3)		LW(1,2,3)		WS (0,1,2)		Total	
	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18
1.	1	1	1	3	2	3	2	1	6	8
2.	1	0	3	3	3	3	2	1	9	7
3.	0	0	1	3	1	2	0	1	2	6
4.	1	1	2	3	3	3	2	2	8	9
5.	0	0	1	3	2	3	1	1	4	7
6.	0	1	1	3	2	3	2	2	5	9
7.	1	1	2	2	1	3	1	2	5	8
8.	0	1	1	3	2	3	1	1	4	8
9.	1	1	2	3	2	2	2	1	7	7
10.	0	1	2	3	2	3	2	2	6	9
Total	56	78								

Mean = 5.6 and 7.8 (CT- Condition of Top; NT- Nodal Transgresim; LW- Lesson Width; WS- White Spot)

Table 2 : Cane production and productivity of CoS 8436 for three years at farmers fields, Bihar.

	2015-16	2016-17	2017-18	Loss due to infection	
				2015-17	2015-18
Cane production (q)	227760	197096	80676	30664	147084
Productivity (q/ha)	780	694	324	86	456
Harinagar mill area planting (ha)	292	284	249	8	43

of cane stalk at right angles was observed. Also, white patches were the identifying feature for this infection. Besides, hollow cane stalk along with white mycelia was also being observed in some of the infected cane stalks. Furthermore, cane stalks gave a peculiar vinegar smell, an identifying smell for red rot infection. This may be due to conversion of sucrose into glucose and alcohol (Duttamajumdar, 2008). Studies have reported that formation of glucose and alcohol also causes severe problem during milling (Duttamajumdar, 2008; Kaur *et al.*, 2014; Sharma and Tamta, 2015). These symptoms were also supported by several other studies conducted (Jayashree *et al.*, 2010). Viswanthan (2011) had also revealed that occurrence of white spots on cane stalks may vary in size and number and at times the infected tissue give a mottled appearance due to its higher number.

Scaling data of ten samples collected from the field showed that in the year 2017-18 variety CoS 8436 was severely affected having scaling of 6 indicating it to be susceptible while in the previous year 2016-17, disease infection was moderately susceptible (table 1).

Data of cane yield, production and productivity for the year, 2015-16, 2016-17 and 2017-18 of the farmer's field showed that higher losses were seen in the year 2017-18 followed by 2016-17 due to the red rot infection on this variety (table 2). As mentioned in the table 2, there was a loss of 147084 q from the year 2015 to 2018 in cane production while 456 q/ha loss in productivity. Also, cane area in harinagar mill showed a decrease of 43 ha from 2015 to 2018. Loss in cane yield and cane production has also been reported in many studies due to infection of red rot (Duttamajumdar, 2008; Kaur *et al.*, 2014; Sharma and Tamta, 2015; Singh *et al.*, 2017).

Conclusion

Red rot infection is a severe infection that hampers the production and productivity of cane. Study concluded that when the incidence rate of red rot infection in sugarcane was received the production, productivity and area of CoS 8436 was decreased. Although proper cultural practices were followed but the sudden arrival of floods in Bihar due to climate change gave favorable conditions for proliferation of this disease in canes. Several

management practices are been known to control the infection but moist hot air therapy (MHAT) of seed cane at 54°C for 4 hr (R.H. 95-100) was found the effective one in such a situation. There is still a need for further study on incidence rate of other varieties of this area as this infection had lead to failure of varieties for commercial use.

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