



ISSN (E): 2277-7695

ISSN (P): 2349-8242

NAAS Rating: 5.23

TPI 2022; 11(6): 655-659

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www.thepharmajournal.com

Received: 03-04-2022

Accepted: 16-05-2022

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Sugarcane disease scenario, possible reasons for their spread and suitable remedies in Bihar condition

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Abstract

Among the various factors responsible for lowering down the production and productivity of Sugarcane, the widespread presence and plenty of diseases are one of them. More than 20 diseases of sugarcane have been reported from Bihar which are caused by various groups of pathogens. Among them red rot, wilt, pokkah boeng, smut, leaf spot, ratoon stunting are important diseases which are occurring in Bihar and furthermore, red rot and wilt diseases are serious issues in Bihar in recent past on the basis of observations made during 2019-2022. The incidence of red rot and wilt diseases of sugarcane ranged between trace to 50 per cent and 5 to 80 per cent respectively in different sugar factories areas of Bihar. The Smut disease varied from trace to 15 per cent, pokkah boeng varied from trace to 20 per cent. While, yellow leaf disease varied from trace to 5 per cent. The approximate losses in sugarcane areas were observed upto 83,750 acres in the state.

Keywords: Sugarcane, diseases, spread, remedies, Bihar

Introduction

Sugarcane (*Saccharum officinarum* L.) is one of the most important agro-industrial sugar producing crop which is vegetatively propagated in the tropics and sub tropics regions. Presently in India, it is grown in an area of 48.57 lakh ha of land with production of 399.25 million tonnes and the productivity of 82.20 tonnes per ha. In Bihar, it is grown in an area of 2.19 lakh ha. of land with a production of 10.71 million tonnes and productivity of 48.92 tonnes per ha. (Adv. Est.- 2020-21) [1]. It is a tall perennial true grass of the genus *Saccharum* belonging to the family poaceae. Sugarcane being a long duration crop stand in the field for about a year and it passes through various seasons and four distinct growth phases (germination, tillering, elongation and maturity) at one time or the other, pathogen find a right temperature and humidity for quick proliferation, spore production and subsequent infection. In the field, a solitary plant may display the symptoms of more than one disease besides having insect pest infestation and these new disease pest combinations further create and complicate the field problems About 180 diseases of sugarcane have been reported from India due to which 10-15 percent of the Nations sugarcane yield is lost due to diseases (Viswanathan and Rao, 2011) [6]. Annual loss of revenues by *Colletotrichum falcatum* infection in India is estimated to be between 500 and 1000 million USD (Edward *et al.*, 2013) [2]. Among these diseases, wilt is a serious disease of sugarcane affecting all stages of crop and is observed from germination to maturity in tropical and subtropical India (Viswanathan 2020) [4]. Recently, increasing trends were observed in most of the sugarcane varieties grown in Bihar *viz.* Co 0238, Co 0118, Co 0233, Co 0235, CoH 160, CoH 167, BO 141, CoPant 97222, Co 92006, CoV 92102, CoSe 95422, BO 147, etc. (Minnatullah and Singh, 2021) [3]. The 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 (Viswanathan, 2012) [5].

More than 20 diseases of sugarcane caused by different groups of pathogens have been reported from Bihar and are mainly responsible for reducing yield as well as deteriorating the cane juice quality thus, resulting considerable loss for both the cane growers and mill owners. Currently red rot, wilt, smut, pokkah boeng (PBD), yellow leaf disease, leaf spot, ratoon stunting, mosaic etc. diseases were observed under different cane mill areas of Bihar. However, wilt and red rot diseases are serious issues among all these diseases in Bihar. In past several times also sugar factories faced the threat of no canes due to diseases under cane growing regions of Bihar. The major possible reasons or contributory factors are introduction of unreleased susceptible varieties from neighboring states or different zones in haphazard

way, production of new virulent pathotypes and frequent changes of climatic conditions under Bihar, which leads to heavy rainfall and prolonged water stagnation in the sugarcane field as they get most congenial condition for their appearance and spread. Since last ten years more than 30 sugarcane varieties were noticed affected with wilt, red rot, smut, pokkah boeng, sett rot, red stripe, mosaic, leaf scald, grassy shoot, leaf spot diseases etc. alone or in combination on a specific variety which plays the major role in deteriorating the different cane parameters. The fungal diseases of sugarcane occupy a major areas and about 45-60 percent under Bihar cane growing regions and still reducing the yield and cane juice quality as well as responsible for elimination of many popular commercial cultivars viz. Co 0238, Co 0233, CoSe 95422, CoSe 92423, CoH 160, CoH 167, CoJ 85, Co 98014, CoS 8436, CoJ 64 etc. Bacterial diseases were noticed and can damage the sugarcane crop up to 5 percent in the state. Whereas, viral diseases also affected several sugarcane varieties with a overall disease incidence of 5-7% when the crop attain 7-10 months followed by heavy rainfall and higher temperature.

Materials and Methods

To study the incidence and severity of the diseases, five plots in each location were visited and observations were recorded on randomly selected hundred plants from three different location at each plot to assess the incidence of the disease, which was calculated by using the following formula:

$$\text{Incidence percentage} = \frac{\text{Number of affected plants}}{\text{Total plants observed}} \times 100$$

Result and Discussion

An extensive survey was carried out during the months of

June to December under different mills areas of Bihar. It was observed that as compared to June the disease (red rot and wilt) severity was higher during the months of August to December. The name of varieties and diseases are depicted in tables (1-6). To gather the information regarding varietal susceptibilities and diseases naturally occurring in Bihar, the survey of sugarcane diseases was undertaken in different cane growing areas of Bihar during the planting seasons 2019-20, 2020-21 and 2021-22.

In course of survey during planting season 2019-20 (Table-1) red rot incidence was noticed in the varieties Co 0233, Co 0238, CoH 167 and Co 0118 in different locations i.e. Bankata, Sidhwalia, Riga, Narkatiaganj and Harinagar. The disease incidence ranged from 2-10 per cent. Smut was observed in the varieties BO 141, Co 0238, CoH167 and CoP 2061 and the incidence was noticed upto 10 per cent at Riga and Manjhaulia. Wilt was observed in the varieties BO 141, Co 0233, Co Pant 97222, Co 0238, Co 92006, Co 0118, CoH 167, Co 0118, CoP 9301 and CoV 92102 and was observed upto 20 per cent in the reported cane growing areas of Bihar. Pokkah boeng incidence was also observed in several varieties like CoV 92102, BO 141, Co 0238, BO 154, CoP 2061 and Co 0118 upto 10 per cent at Riga, Manjhaulia, Gopalganj, Pusa and Kalyanpur Farm. The disease drastically reduced after the monsoon showers. Yellow leaf disease was also noticed in Pusa, Harinagar, Narkatiaganj, Gopalganj and Harpur sugarcane growing areas in traces to 5 per cent on varieties, Co 0233, Co Pant 97222, Co 0238, Co 0118, CoV 92102. Incidence of mosaic and leaf spot diseases were also noticed in traces to 5 per cent in varieties Co 0233, Co Pant 97222, Co 92006, Co 0118 and CoV 92102 at Pusa research farm.

Table 1: Survey of sugarcane diseases naturally occurring on different cane varieties (2019-20)

| Varieties | Diseases | Locations |
|---------------|--|--|
| BO 141 | PBD (2%), Smut (2-10%), Wilt (5%) | Riga |
| Co 0233 | Mosaic (T), YLD (2%), Red rot (5%), Wilt (10-25%), | Bankata (Gopalganj), Riga |
| Co pant 97222 | YLD (T), leaf spot (2%), Wilt (10%) | Riga, Gopalganj, Hasanpur, Pusa |
| Co 0238 | PBD (10%), Smut (5%) | Riga |
| Co 0238 | PBD ((5%), Smut (15%) | Manjhaulia |
| Co 0238 | Wilt (20%), Red rot (5-10%) | Sidhwalia |
| Co 92006 | Wilt (5%) Mosaic (5%) | Bhagwanpur (Gopalganj) |
| Co 0118 | Mosaic (2-5%) leaf spot (25%), Wilt (10%), YLD (T), PBD (5%) | Gopalganj |
| CoH 167 | Smut (2%), Wilt (15%), red rot (5-10%) | Gopalpur Farm (Riga) |
| Co 0118 | YLD (T), Wilt (20%), Red rot (10%) | Belahiya, Kutirpur, MahwaBhusa, (Narkatiaganj) |
| CoP 9301 | Wilt (2-5%) | Narkatiaganj |
| Co 0238 | Wilt (5-15%), YLD (T), red rot (2-5%) | RaibariMahuwa, Bariyawar (Harinagar) |
| Co 0238 | Wilt (5-10%), PBD (10%), YLD (T) | Hsanapur |
| BO 154 | PBD (5%) | Kalyanpur Farm, Pusa |
| CoP 2061 | PBD (5%), Smut (T) | Manjhaulia |
| CoV 92102 | YLD (5%), Wilt (10%), PBD (T), Mosaic (2%) | Pusa |

*T – Trace

During planting season 2020-21 (Table- 2 and 3) was observed that most of the varieties was affected with red rot, wilt and pokkah boeng diseases where the susceptible varieties like CoSe 95422, BO 128, CoJ 64, CoH 160, CoH 167, Co 0238, Co 0233 and Co 0235 are being cultivated. The incidence of pokkahboeng and smut diseases was noticed in Lauriya and Hasanpur areas. Smut ranged between 5-10 percent and PBD varied upto 10-15 per cent. In Gopalganj areas Co 0118 was affected with wilt (5-20%) and red rot

upto 5%, variety CoP 2061 affected with wilt and PBD upto 5%, Wilt upto 10% and PBD 5-10% was noticed in variety Co 0118 and variety Co 0238 was found affected with YLD varied from (T-2%), red rot (5-10%) and wilt (5-25%) in Sugauli sugar mill areas. Incidence of red rot upto 30%, wilt varied from 30-50% and YLD 2-5% was recorded in variety Co 0238 at Manjhaulia sugar factory areas. Severe incidence of red rot and wilt diseases was observed in varieties Co 0238, CoH 160 and CoH 167 in Riga Sugar factory areas. In variety

Co 0238 red rot was noticed upto 30% and wilt ranged between 30-40% and YLD 2%. In variety CoH 167 red rot was observed 10-40% and wilt varied from 20-50%. Variety CoH 160 was affected with red rot, wilt and smut diseases and varied between 10-30%, 50-70% and 10-15% respectively. Co 0233 was observed with wilt 30-40% red rot 30%, PBD 5% and 2% mosaic incidence whereas, in variety BO 154 was observed with smut upto 2% and PBD 5-10%. In Sidhwalia sugar factory areas variety Co 0118 was affected with wilt

upto 10% and red rot ranged between trace to 2%, Co 0238 with red rot 15-20%, wilt upto 40%, CoP 2061 with wilt disease and varied from 2-5%. In Pusa, variety BO 154 was noticed with PBD upto 5%, CoV 92102 with YLD upto 2%, PBD 10% and mosaic upto 5%. CoP 9301 was found affected with PBD varied from 2-5% at Kalyanpur while, red rot in combination with wilt was noticed in between 10-20% incidence at Narkatiaganj sugar factory area.

Table 2: Survey of sugarcane diseases naturally occurring on different cane varieties (2020-21)

| Varieties | Diseases | Locations |
|-----------|---|--------------|
| Co 0238 | Smut (10%), Pokkahboeng (15%) | Lauriya |
| Co 0238 | Smut (5%), PBD (10%) | Hasanpur |
| Co 0118 | Wilt (5-20%), Red rot (5%) | Gopalganj |
| CoP 2061 | Wilt (5%), Pokkahboeng (5%) | Gopalganj |
| Co 0118 | Wilt (10%), PBD (5-10%) | Sugauli |
| Co 0238 | YLD (T-2%), Red rot (5-10%), Wilt (5-30%) | Sugauli |
| Co 0238 | Red rot (30%), Wilt (30-50%), YLD (2-5%) | Manjhaulia |
| Co 0238 | Red rot (30%), wilt (30-40%), YLD (2%) | Riga |
| CoH 167 | Red rot (10-40%), wilt (20-50%) | Riga |
| CoH 16 | Red rot (10-30%), Wilt (50-70%), Smut (10-15%) | Riga |
| Co 0233 | Wilt (30-40%), Red rot (30%), PBD (5%), Mosaic (2%) | Riga |
| BO 154 | Smut (2%), PBD (5-10%) | Riga |
| Co 0118 | Wilt (10%), Red rot (T-2%) | Sidhwalia |
| Co 0238 | Red rot (15-20%), Wilt (40%) | Sidhwalia |
| CoP 2061 | Wilt (2-5%) | Sidhwalia |
| BO 154 | PBD (5%) | Pusa |
| CoV 92102 | YLD (5%), PBD (10%), Mosaic (5%) | Pusa |
| Co 0238 | Red rot in combination with wilt (10-20%) | Narkatiaganj |
| CoP 9301 | Pokkah boeng (2-5%) | Kalyanpur |

Table 3: Sugarcane varieties affected with diseases in percent (2020-21)

| Sl. No. | Variety | Red rot | Smut | Wilt | PBD | Mosaic | YLD |
|---------|-----------|---------|--------|--------|--------|--------|------|
| 1. | Co 0238 | 5-30% | 5-10% | 5-50% | 10-15% | - | T-5% |
| 2. | Co 0118 | T-5% | - | 5-20% | 5-10% | - | - |
| 3. | CoP 2061 | - | - | 2-5% | 5% | - | - |
| 4. | CoH 167 | 10-40% | - | 20-50% | - | - | - |
| 5. | CoH 160 | 10-30% | 10-15% | 50-70% | - | - | - |
| 6. | Co 0233 | 30% | - | 30-40% | 5% | 2% | - |
| 7. | BO 154 | - | 2% | - | 5-10% | - | - |
| 8. | CoV 92102 | - | - | - | 10% | 5% | 5% |
| 9. | CoP 9301 | - | - | - | 2-5% | - | - |

Whereas, during planting season 2021-22 (Table-4 and 5) it was observed that most of the varieties were affected with red rot, wilt and pokkah boeng diseases while, few varieties were also affected with Smut and YLD having low incidence. The incidence of wilt (20-40%), Red rot (5-40%) and PBD (T-5%)

was noticed in variety Co 0238 under Sidhwalia sugar factory areas. Under Riga sugar factory areas the varieties affected with wilt, red rot, PBD and smut diseases in the varieties Co 0238, CoH 160, CoH 167, CoJ 85, Co 98014 and PV 92. The incidence of wilt and red rot diseases are noticed in variety Co 0238 under Manjhaulia, Gopalganj, Harinagr, Narkatiaganj, Sugauli and Hasanpur Sugar mills areas. In case of wilt ranged between (5-80%) while, in case of red rot varied from (5-40%) other diseases like smut (T-5%), PBD (5-15) and YLD (T-5%). Varieties BO 154 (2-5%) and CoP 2061 (5%) was also affected with PBD in Riga and Gopalganj mills areas. While, Co 0118 was affected with wilt disease (5-10%) in Sugauli mill areas. It was also noticed that variety Co 0238 was affected with red rot in combination with wilt disease in most of the surveyed locations. The approximate losses due to red rot and wilt diseases were also noticed under different sugar factories are depicted in table- 6.

Table 4: Survey of sugarcane diseases naturally occurring on different cane varieties (2021-22)

| Varieties | Diseases | Locations / Areas |
|-----------|--|---|
| Co 0238 | Wilt (20-40%), Red rot (5-40%), PBD (T-5%) | Sidhwalia (Shahpur, Muhammadpur, Manjhaua, Madhopur, Binupur) |
| Co 0238 | Wilt (20-60%), Red rot (20-50%), PBD (5-20%), Smut (5-10%) | Riga (Dumariya, Purnahiaya, Rebari, Gopalpur) |
| CoH 160 | Wilt (10-60%), Red rot (5-40%), PBD (5-15%) | Riga (Rebari, Gopalpur) |
| CoH 167 | Wilt (10-80%), Red rot (10-60%), PBD (5-15%) | Riga (Rebari) |
| CoJ 85 | Wilt (5-20%), Red rot (5-10%), YLD (T-2%) | Riga (Kharsan) |
| Co 98014 | Wilt (5-20%), Red rot (5-10%) | Riga (Dumariya) |
| BO 141 | Wilt (5-15%), Smut (5%), PBD (T-5%) | Riga |
| PV 92 | Wilt (5-30%), Red rot (5-20%) | Riga (Purnahiaya, Gopalpur) |
| Co 0238 | Wilt (30%), Red rot (5-10%) | Harinagar (Sigri Murila, Chamua, Binvalia) |
| Co 0238 | Wilt (10-40%), Red rot (5-40%) | Gopalganj (Sipaya) |

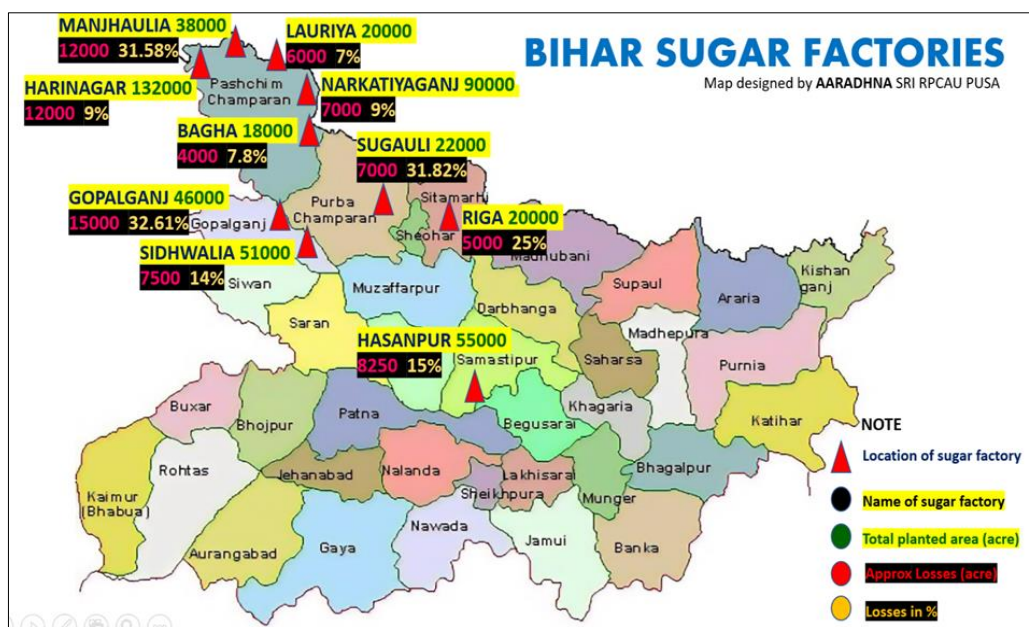
| | | |
|----------|--|---|
| Co 0238 | Wilt (20-80%), Red rot (5-40%), PBD (5-15%), Smut (T-5%) | Majhulia (Madhopur, Senwariya, Barwariya) |
| Co 0238 | Wilt (5-25%), Red rot (5-10%) | Narkatiaganj |
| Co 0238 | Wilt (10-40%), Red rot (5-30%), YLD (T-5%) | Sugauli |
| Co 0238 | Wilt (5-15%), Red rot (2-10%) | Hasanpur |
| Co 0118 | Wilt (5-10%) | Sugauli (Belwatiya) |
| BO 154 | Pokkah boeng (2-5%) | Riga |
| CoP 2061 | Pokkah boeng (5%) and Wilt (5%) | Gopalganj |

Table 5: Sugarcane varieties affected with diseases in percent (2021-22)

| Sl. No | Varieties | Red rot | Smut | Wilt | PBD | YLD |
|--------|-----------|---------|-------|--------|-------|------|
| 1. | Co 0238 | 5-50% | T-10% | 5-80% | 5-20% | T-5% |
| 2. | CoH 160 | 5-40% | - | 10-60% | 5-15% | - |
| 3. | CoH167 | 10-60% | - | 10-80% | 5-15% | - |
| 4. | CoJ 85 | 5-10% | - | 5-20% | - | T-2% |
| 5. | Co 98014 | 5-10% | - | 5-20% | - | - |
| 6. | BO 141 | - | 5% | 5-15% | T-5% | - |
| 7. | CoP 2061 | - | - | 5% | 5% | - |
| 8. | PV 92 | 5-20% | - | 5-30% | - | - |
| 9. | Co 0118 | - | - | 5-10% | - | - |
| 10. | BO 154 | - | - | - | 2-5% | - |

Table 6: Approximate Planted area and losses under different sugar factories of Bihar (2020-22)

| Sugar Factories | Total Planted Area (Acre) | Approx Losses (Acre) |
|-----------------|---------------------------|----------------------|
| Riga | 20,000 | 5,000 (25%) |
| Sidhwalia | 51,000 | 7,500 (14%) |
| Gopalganj | 46,000 | 15,000 (32.61%) |
| Harinagar | 1,32,000 | 12,000 (9%) |
| Hasanpur | 55,000 | 8,250 (15%) |
| Sugauli | 22,000 | 7,000 (31.82%) |
| Manjhulia | 38,000 | 12,000 (31.58%) |
| Narkatiyaganj | 90,000 | 7,000 (9%) |
| Bagaha | 18,000 | 4,000 (7.8%) |
| Lauriya | 20,000 | 6,000 (7%) |
| Total | 492,000 | 83,750 (17.02%) |



Map 1: Map showing Approximate Planted area and losses under different sugar factories of Bihar during 2020-22

Sugar factories located in Bihar

1. General observations on spread of sugarcane diseases in Bihar

It has been observed that more than 25 unreleased/unrecommended varieties from other zones/states are invariably used by the cane growers and sugar factories which increases the inoculum load and creates a way to unwanted diseases in the state like Bihar in which more than 40% areas are under water logging. It was also noticed that the varieties which are highly susceptible are also being cultivated due to lack of awareness among the cane growers and sugar factories. Unrestricted and haphazard movement of surplus cane from diseased infested areas to cane deficit areas. These days there is a competition among the sugarcane factories to crush more and more cane within a limited period, hence they brought cane without quarantine law resulting new diseases has come up in the state. To overcome on these issues a regulatory body at noticed level may be constituted to monitor

for the disease problem and varieties status to restrict the movement of un-recommended varieties in the Bihar state.

2. Lack of very sound seed programme

Majority of the diseases are sett borne causing considerable losses both for the farmers as well as mills owners. Only way to mitigate the losses there should be sound seed production programme. Only varieties showing resistant to moderately resistant diseases may be included in seed production programme The varieties having moderately resistant to resistant reaction against major diseases of sugarcane will mitigate the losses due to diseases occurring in the state are:- Rajendra Ganna 1 (CoP 16437), Rajendra Ganna 2 (CoP 09437), Rajendra Ganna 3 (CoP 18437), Rajendra Ganna 4 (CoP 20440), Rajendra Ganna 5 (CoP 11438), CoP 9301, CoP 2061, CoP 112, CoP 09437, CoP 11438, BO 153, BO 154, CoP 17446, CoP 17436, CoP 17437, CoP 16455, CoP 16456, etc.

3. Low adoption of sett treatment for a proper period

Sett treatment is recommended with bavistin 0.1% for at least 30 minutes. To protect the sett from soil borne (Sett rot) as well as externally sett borne diseases particularly red rot, wilt and smut diseases, but in Bihar cane growers did not treat the setts before planting in the field. However, in some factories areas farmers treat the setts with fungicides only for zero minute (dip in and out) which is not the proper method of treatment. So there is need to popularize the practices of treatment with chemicals as well as bio-agents for a proper period.

4. Non-adoption of crop rotation

Soil borne diseases can be brought under control by adopting the crop rotation with non-host crop. Incidence of red rot and wilt diseases was observed minimum in plots in which onion or garlic was cultivated at least for 2-3 years due to starvation and exudation of chemicals from the roots of onion and garlic. Due to monoculture of sugarcane over large areas, there is always a chance of outbreaks of sugarcane diseases. There is need to grow 4-5 sugarcane varieties, along with different crops to prevent the wide spread of inoculum and helps in different cane parameters.

5. Lack of survey and monitoring of diseases

To know the disease situation and susceptibility of sugarcane varieties cultivated in particular areas, proper survey and monitoring is essentially required so that susceptible varieties must be replaced by resistant one.

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