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Epidemics of major sugarcane diseases in Central and Western Uttar Pradesh in last 14 years.

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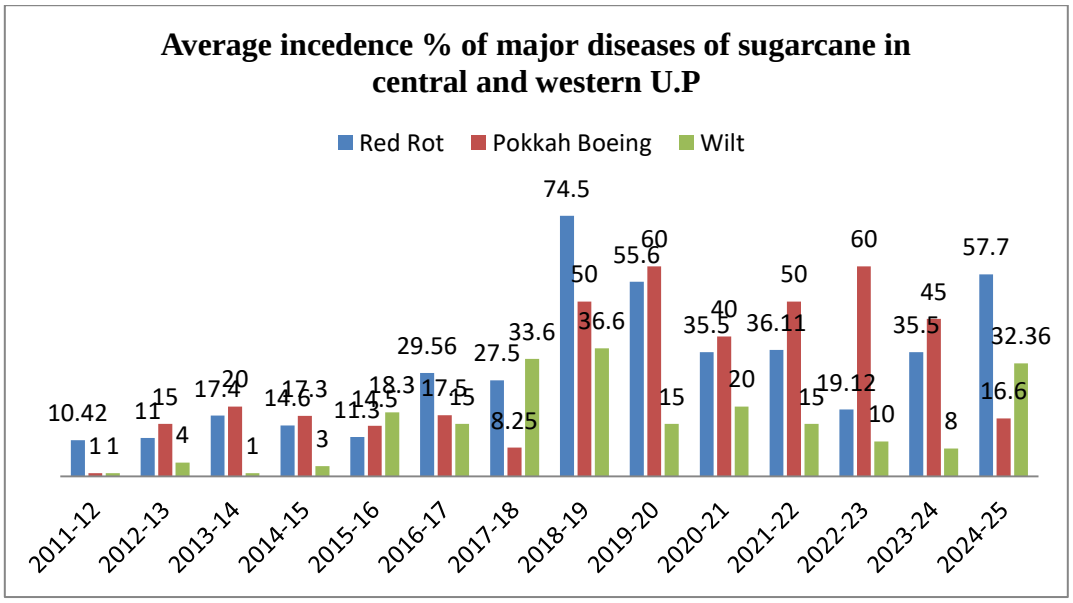
INTRODUCTION

Sugarcane (*Saccharum officinarum*)is one of the most important agro-industrial crops of India next to textile industry. It is grown in both tropical and subtropical regions of the country, later has a major concern with respect to the total pool of sugar production in the country. Productivity of sugarcane is function of many factors such as climate, soil, cultivar and biotic and abiotic stresses. Among these, the losses caused by the diseases are combination of biotic and abiotic stresses which is crucial in nature in reducing the production and productivity of sugarcane. The area covered by cultivation of sugarcane in Uttar Pradesh is around 28.53 lakhs hectare with a productivity of 839 quintals/ha. About 55 diseases of sugarcane caused by fungi, bacteria, viruses, phytoplasma and nematodes have been reported from India. About 10–15 per cent of the nation sugar produced is lost due to the diseases (Viswanathan and Rao, 2011).

Epidemic history of three major diseases of sugarcane; last 14 years.

The incidence of red rot disease in western and central UP, suddenly increased from 27.5 percent to 74.5 percent in 2018-19. The main reason for this was that a single sugarcane variety Co 0238 took over most of the area in western and central Uttar Pradesh. Co0238 is a popular standard variety of sugarcane, but it is a single variety covering 95% of sugarcane cultivation area, at that time the symptoms of red rot disease were seen sporadically in Co0238 variety. In 2011-12, the incidence of the disease was around 10.42 percent. If precautions were taken at the time of sowing and sowing was done after seed treatment, then the varieties would have been able to last for a long time. If this was not done, the causative organism of red rot disease, *Colletotrichum falcatum*, made its new variant so strong and effective that most of the sugarcane varieties came under the grip of the disease due to the isolate of Co0238. As a result, it became difficult to control the epidemic.

In 7 years, the incidence of the disease was controlled by adopting sugarcane variety change and other disease management methods, but even now the incidence of the disease is more than 50 percent. Even today, in many sugar mill areas in western Uttar Pradesh, more than 50 per cent of the area is covered by a single variety, Co. 0238. Pokkah boeing is an air borne disease of sugarcane caused by a *Fusarium spp*. Sugarcane variety Co 0238 is highly susceptible to Pokkah boeing For this 26 to 32 degree Celsius temperature along with 75-80 % atmospheric humidity is important for disease development. As can be seen in the graph, the maximum incidence of the disease reached 60 percent in 2019-20 and 2022-23. In the same years in which the incidence of red rot disease has increased, the incidence of wilt has also been increasing and decreasing year after year. The main reason for this is the association of the causative organism of red rot and wilt disease. As you can see through the graph the ups and downs from 2014-15 till present.



Graph.1: Epidemics of Red rot, wilt and Pokkah boing of sugarcane at a glance.

About major diseases of sugarcane

Red Rot

This is one of the most destructive and earliest recognised diseases of sugarcane and is prevalent in all the sugarcane growing tropical and sub-tropical areas in India and world. Red rot is also named as cane 'cancer' was considered as one of six major fungal disease affecting sugarcane. It is a very dangerous, fungal disease caused by ***Colletotrichum falcatum*** **Went**. It is demonstrated by numerous references to its economic importance as the world has witnessed severe red rot epiphytotic at different times**. It was first time reported as a disease of sugarcane by Went in java now Indonesia in 1893 (Went, 1893)**. He analyzed healthy and diseased mature stalks of cane and found that the disease causes greater losses in sucrose content in the milling cane, which was later on renamed as red rot by butler in 1906 in India. Red rot of sugarcane may infect developed stems of cane, leaf mid ribs which results in considerable damages in sugar quality (Rao *et al.*, 2008). The pathogen is setts and soil borne and inactive mycelia existing in the bud scales are responsible for post-germination and contaminate the freshly developing shoots of cane (Viswanathan, R and Rao, 2011). Butler and khan 1913, the use of disease free seed cuttings was emphasized as the most important means of controlling the disease which they stated was the greatest obstacle to successful sugarcane cultivation in many part of India.

Symptom of Red Rot

Disease symptoms are seen in almost all crop stages in field. However initial symptoms of the disease are noticed in the 30 days after germination in the month of April-May, during germination phase, the pathogen cause symptoms of pre-germination death of buds and drying of germinated shoots and the critical symptoms of the disease are observed after cane formation during the growth stages of the crop in the months of August-October. The infection of Red Rot disease in sugarcane mainly occurred in two types.

1. Primary infection 2. **Secondary infection**.

Primary infection

The primary symptoms of red rot disease at this stage mostly appeared on the midrib of the 3-4 leaves of infected plant, round pearls like structures appear on the midrib of the infected plants can be easily seen, in the case of severe infection in primary stage whole plant die and 100 percent losses to the farmers and same condition in the case of sowing of contaminated seed sets of sugarcane, the pathogen attack on seed setts and taken the food materials from seed setts before the germination of the seed buds so that the seed buds killed and 100 percent losses in germination of seed buds. Characteristics symptom of the disease are seen after cane formation in the month of August- September.

Fig.1: Primary symptoms of red rot; pearl like structures appear on the midrib of the leaf.

Secondary infection

Symptoms of secondary infection of red rot disease appear in the form of yellowing on the second and third leaves of the infected plant in the months of August to September. In case of acute infection of the disease, all the leaves of the infected plant dry up and sprouting takes place in the nodes and the effects of the fungus on the nodes become clearly visible. This situation is seen in October to November. In such a situation, when the infected sugarcane is torn from the middle, the inner pulp appears red in colour and when smelled, it gives out an alcohol-like smell. The mycelium of the fungus is seen growing in the fleshy part of the sugarcane i.e. parenchymatous tissue from top to bottom crossing the nodes. White spots are seen in the pithy region which gradually turns from block to brown in colour.

Fig.2: Internally symptoms of Red Rot.

Wilt

Wilt is one of the earliest known diseases of sugarcane in India and was first reported by Butler (1906) from Bihar state. Wilt epidemics in India during the last century resulted in elimination of many commercial cultivars from cultivation (Kirtikar *et al*., 1972; Singh and Singh, 1974; Subba Raja and Natarajan, 1972). Later also very severe wilt incidences were noticed in South Gujarat and in different parts of Gangetic plains. Country-wide disease assessment revealed that wilt of 60% on Co 7717, 5-10% in CoJ 64, CoJ 79 and CoS 767 in Uttar Pradesh, severe wilt incidence in combination with red rot noticed on major varieties in Bihar, severe wilt incidence on Co 89003 and moderate wilt on Co 7717, CoS 8436 and CoS 88230 in Punjab, varying levels of wilt in most of the varieties in cultivation in South Gujarat, mild wilt on popular varieties in Maharashtra and in Madhya Pradesh (Agnihotri and Rao, 2002). Previous studies of Viswanathan *et al*. (2006) revealed that the disease intensity vary from trace to 75% in different states of India. Wilt in the cv. Co 7805, an elite variety in coastal Andhra Pradesh caused enormous loss to sugarcane production in the past two decades (Viswanathan, 2013a). Butler and Khan (1913) for the first time described the disease in India in sugarcane under the term ‘wilt’ and noted Cephalosporium sacchari as the causal agent. However, Bourne (1922) recorded a stem rot disease of the basal portions of unwounded sugarcane stems having a species of Wilt Diseases of Crops (2019): 493-517 Eds:Ashok Bhattacharyya, B.N. Chakraborty, R.N. Pandey, Dinesh Singh and S C. Dubey Today and Tomorrow Printers and Publisher, New Delhi. India 494 Fusarium associated with the disease in Barbados. Abbott (1932) noted a purple species of Fusarium constantly associated with diseased cuttings in Louisiana and also reported the presence of a purple and white strain of Fusarium in seed cuttings. Bourne (1953) recorded the Fusarium stem rot as prevalent during the period 1949-52 in the Everglades region of Florida, and considered it was just as important to breed canes resistance to it as to red rot itself. Apart from India, the disease has been reported from 34 countries in different continents (Rao and Agnihotri, 2000).

Fig.3: Symptoms of wilt, pre wilting symptoms yellowing of leaves and stalk infection.

Pokkah boeing Disease (PBD)

Pokkah boeing (PB) in sugarcane was first characterized and observed by Walker and Went (1896) in Java. The term 'pokkah boeng', originally derived from 'Javanese term' stand for malformed or distorted top. Wind borne fungus settle in cane spindle causes the disease. Generally, a hot humid and rainfall condition favours the disease development and early stages of sugarcane were more prone to PB infection than the matured canes (Martin et al., 1961; Raid and Lentini, 1991). In India, the disease was first recorded during 1930s and in 1940s. Earlier severe incidences of the disease were reported from Maharashtra and subsequently PB was reported from other states (Patil *et al*., 2007; Viswanathan, 2012a,b). Vishwakarma *et al*. (2013) recently reported that the PB severity increased in the country based on detailed surveys during 2007-2013. Barnes (1974) reported that PB was one of the serious diseases of sugarcane and farmers often worry by its sudden spectacular appearance in their fields (King et al., 1953). The disease occurs throughout the sugarcane growing countries in the world. Recently in China, PB has been reported as a major threat in sugarcane cultivation (Lin *et al*., 2014). PBD in sugarcane is frequent in the field throughout the monsoon and post-monsoon seasons throughout the nation. It is strongly impacted by favorable meteorological conditions such as high humidity and warmth. The signs of this illness appear in canes that are 3-5 months old, and rainfall favors pathogen infection. Symptoms may appear in young leaves, the top of a plant, or as chlorosis develops. Following infection, the basal portions of new leaves emerging from the spindle became twisted, wrinkled, and shorter. In recent years, disturbingly high PB occurrences have been reported from several regions of India, including a severe case of PBD in Co 0238, Uttar Pradesh.

Symptoms

Mainly three types of symptoms are seen in Pokka boeing disease number first Chlorotic stage second Top-rot stage and third knife cut stage. The afflicted plants will be unique and may be very clearly noticed from a distance. The damaged crown leaves have chlorotic spots at the base of the young leaves, as well as on other regions of the leaves and leaf sheath. Later, disease manifestation is marked by significant yellowing, wrinkling, twisting, and shortening of the leaves, as well as deformity or deformation of juvenile leaves (Fig. 5). During this stage, leaf lamina may break off in the deformed laminar area. Occasionally, newly developing leaves will be damaged. Only the spindle core will be visible in the crown. Knife-cut phase occurs during severe disease expression, when the fungus infects stalk tissues. During this phase, shorter internodes show knife-cut symptoms caused by partial or irregular pathogen infections.

Fig.3: Chlorotic, Top-rot and Knife cut Symptoms of PBD in sugarcane.

EFFECT OF DISEASE

- During epidemic, entire fields dry up due to which farmers have to face heavy economic loss in yield, which affects the economy.
- Due to drying of agola, due to which fodder is not available for feeding animals.
- Sowing infected seeds leads to less germination, chances of spread of disease are high, extra expenditure has to be made for disease control, still abundant yield is not obtained.
- Due to formation of enzyme called invertase in infected sugarcane, crystals of sucrose and glucose are not formed.
- The amount of molasses increases in sugarcane and sugar content decreases. Due to which sugar mills suffer heavy losses, sugar production decreases.
- Due to infection, sugarcane ratoon is affected, if the disease spreads in a severe form, then 100% loss in sugarcane ratoon is also possible.

PREVENTION

- A crop cycle of at least three years should be adopted. So that the pathogen does not survive in the absence of a host plant.
- Before sowing, the seed sets should be treated with a solution of 0.1% carbendazim 50% WP or thiophanate methyl 70% WP fungicide and then sown.
- The infected sugarcane clump should be uprooted from the root and thrown away or destroyed by burning. Bleaching powder should be sprinkled on the uprooted place or drenching should be done with a solution of 0.2% thiophanate methyl or azoxystrobin 18.2 + difenoconazole 11.4 SC percent.
- Always sow healthy and certified disease resistant sugarcane seeds.
- Treat the soil with Trichoderma or Pseudomonas culture at the rate of 10 kg/ha.

SUGGESTION

- Sow sugarcane on time like autumn sugarcane should be sown from the second week of October to 15th November and spring sugarcane should be sown from 15th February to 15th March.
- Before sowing, do soil treatment with Trichoderma at the rate of 10 kg/ha.
- Always sow healthy seed sugarcane, if possible, sow the seed plot separately so that healthy seeds can be obtained next year.
- Always sow the latest developed sugarcane varieties resistant to red rot disease like- Kosa. 13235, Kosa. 17231, Kosa. 18231, Kolkh. 16202, Kosa. 8436, Kolkh. 14201, Kosa. 15023, Kosa. 0118, Kosa. 8272, Kosa. 8279.
- In waterlogged areas, sow only early varieties- Kolkh. 94184, Kosha. 10239.

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