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To study symptomology and to find resistant genotypes against Pokkah boeng disease of sugarcane

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Abstract

Sugarcane (*Saccharum officinarum* L.) is an important C₄ crop grown in tropical and subtropical regions for sugar, jaggery, ethanol, and other by-products. India is among the leading producers, with millions of farmers depending on it for livelihood. However, the crop suffers from biotic stresses, of which Pokkah boeng disease, caused by *Fusarium moniliforme*, is emerging as a major threat due to its severity and spread. Disease symptoms are categorized as mild, moderate, or severe. Initial symptoms include whitish chlorotic lesions, followed by curling, twisting, and knife-cut lesions, ultimately leading to top rot, where the spindle leaf dies. Pathogen isolation from infected leaves confirmed *Fusarium moniliforme*. A total of 21 sugarcane genotypes, including 13 new entries and 8 checks, were screened under natural field conditions using a 0-4 scale. Sixteen genotypes were resistant, one (CoM 23003) moderately susceptible, three susceptible (CoM 23004, CoM 23005, CoM 23006), and one (Co 99004) highly susceptible.

Keywords: Sugarcane, Pokkah boeng, symptomology, genotype screening

1. Introduction

Sugarcane (*Saccharum officinarum*) is the major C₄ cash crop, having significant economic value and it is widely grown commercial crop grown around the world. It belongs to grass family Poaceae and the genus *Saccharum* comes under the tribe Andropogon which is mainly found in tropical and sub-tropical regions. The symptoms of Pokkah boeng in Sugarcane mainly occurs in four stages chlorotic-I and II, Top rot and Knife cut symptom (Vishwakarma *et al.*, 2013) [8]. The very first symptom of Pokkah boeng disease is chlorosis towards the base of young leaves followed by twisting and wrinkling and malformation of leaves. Top rot or acute phase is the serious symptoms in which whole base of the spindle gets rotten and it forms a top-rot of the tender tissues of the apical part of the cane. Knife cut phase is also observed in association with the acute phase characterised by transverse cut in the rind of the stalk, as if the tissues are removed with the sharp knife. A study on major (N, P and K) and minor nutrients (S, Zn, Fe, Cu, and Mg) on sugarcane plant affected by Pokkah boeng disease revealed a declined trend in nutrient level within the stalk and leaves of diseased plant as compared to healthy plant. The disease incidence predominantly observed in broad leaves sugarcane varieties particularly in monsoon season potentially leading to reductions in cane weight, internode length, juice percent, girth, pol percent, and total sugars in juice in infected varieties such as CoS 8436 and CoS 88230 (Singh *et al.*, 2006) [7]. The mycelium of *Fusarium moniliforme* is observed to be thick and cottony texture and the powdery appearance is due to production of macroconidia. The *In-vitro* studies revealed that *Fusarium* species cultures form colonies that are woolly, cottony, flat or spreading in appearance (Mui-Yun, 2003) [4]. From the above the colony displays white, cream, cinnamon, salmon, yellow, red, violet, pink or purple meanwhile, the underside of the colonies may exhibit shades such as tan, red, dark purple, brown, or may even appear colourless. Numerous compounds produced by *Fusarium* species have been reported as harmful or potentially harmful compounds or secondary metabolite with deoxynivalenol (DON) and its derivatives (Munkvold, 2017) [5].

2. Materials and Methods

2.1 Symptomology

Diseased samples showing typical Pokkah boeng symptoms was collected from different sugarcane growing farmer's field and Central Sugarcane Research centre farm, Padegaon. The collected samples were brought to the laboratory for critical observation and preserved for further investigations. Visual and microscopic examination of diseased samples were carried out to study the symptoms on leaves and the pathogen associated with them. Naturally field symptoms and sign observed on different samples was critically observed and recorded accordingly.

2.2 To identify resistant sugarcane genotypes included in station trial against Pokkah boeng disease under natural field condition.

With a view to identify the resistant entries against Pokkah boeng, the screening of 13 entries along with eight checks under natural field condition was carried out during *Suru* 2024 at Central Sugarcane Research Centre farm, Padegaon. Setts were planted in two rows (row-row distance was 1.20 m) of six meter length by conventional method of planting, maintaining 2 replications for each genotypes in randomized block design. All the recommended agronomical package of practices was adopted for raising the crop.

Experimental details

1. **Location:** Central Sugarcane Research Station, Padegaon
2. **Crop:** Sugarcane
3. **Season:** *Suru* 2024
4. **Observation period:** Weekly interval
5. **Plot Size:** Two rows of six meter length for each entry
6. **Fertilizer dose:** 250: 115: 115 kg N, P₂O₅ and K₂O/ha
7. **No. of genotypes:** 13 + 8 (Checks) =21

1. CoM 23001
2. CoM 23002
3. CoM 23003
4. CoM 23004
5. CoM 23005
6. CoM 23006
7. CoM 23007
8. CoM 23008
9. CoM 23009
10. CoM 23010
11. CoM 23011
12. CoM 23012
13. CoM 23013
14. CoVSI 08005 ©
15. CoM 15012 ©
16. CoM 0265 ©
17. Co 86032 ©
18. Co 740 ©
19. Co 7219 ©
20. Co 7527 ©
21. Co 99004 ©

3. Results and Discussion

3.1 Symptoms of Pokkah boeng disease

Naturally field symptoms and sign of Pokkah boeng disease were observed on different samples across various growth stages of sugarcane under field conditions and the symptoms

typically appear mid growth stage i.e. 3 to 7 month of crop. The disease is most prominently observed in the whorl region of young, actively growing plants and progresses rapidly under favourable environmental conditions such as high humidity and warm temperatures. The other favourable conditions for the Pokkah boeng disease include lack of drenched conditions of soil, existence of susceptible varieties and constant cultivation of same varieties. The fungus *Fusarium* species complex produces various kinds of secondary metabolites called mycotoxins which can easily enter humans and animals through food and feed because of their resistance to milling, processing and heating (Marasas *et al.*, 1991) [2]. The nature and severity of symptoms may vary depending on the sugarcane variety, crop stage and environmental factors. Accurate identification of these symptoms and sign is essential not only for field diagnosis but also for implementing timely control measures to minimize yield loss and disease spread.

3.1.1 Mild Symptoms

In the mild form, the disease was characterized by early signs such as chlorotic (yellowish) streaks and stripes on the younger leaves, slight wrinkling, twisting and curling of spindle leaf blades and leaf tearing with varying intensities. The symptoms under this category include:

A. Chlorosis or whitish streaks and stripes

The first noticeable symptoms of infection often include pale yellow or whitish linear streaks begin to appear along the midrib or margins of the newly emerged leaves. These are often first visible symptoms and are caused by localized fungal invasion disrupting chlorophyll production.

B. Twisting and curling of leaves

Infected sugarcane plants often exhibit twisting, curling, or crinkling of the leaf blades, particularly in the younger leaves. These deformities are attributed to uneven cell growth triggered by the production of fungal toxins, which interfere with normal leaf development.

C. Tearing of leaves

The leaf blades of infected sugarcane plants tear longitudinally, often along the midrib or veins. These tears are irregular and can be mistaken for physical/mechanical damage, but they are actually due to fungal weakening of the leaf tissues. The fungal pathogens produces toxins and enzymes that weakens the leaf tissue which makes the leaf fragile and brittle which leads to split or tear due to wind or natural unfolding.

3.1.2 Moderate Symptoms

When the disease progresses and environmental conditions remain favourable (especially high humidity), the symptoms become more severe and affect not just the leaves but also the central shoot.

A. Top Rot

One of the hallmark symptoms of moderate Pokkah boeng infection is top rot, which results from the pathogen invading and destroying the growing point or shoot apex of the plant. The infection leads to necrosis of the terminal tissues, causing the top portion of the plant to appear rotten, soft and water-soaked. This observation is attributed to the spread of infection from the leaf to the stalk through the

growing point, which is consistent with the findings of Martin *et al.*, (1961) [3] and Raid and Lentini (1991) [6].

B. Reddening of leaf:

Another symptom occasionally observed at the moderate stage is the reddening of leaf blades, particularly in response to prolonged stress caused by fungal infection. This reddening is considered a secondary symptom, often arising due to nutrient imbalances, physiological disruptions or vascular impairment induced by the pathogen. The reddish discoloration may appear as streaks or blotches, especially near the leaf margins or midribs and is more prominent when the plant is under abiotic stress in addition to biotic infection.

3.1.3 Severe Symptoms

The severe stage of Pokkah boeng disease represents the most destructive phase of infection, predominantly observed in highly susceptible sugarcane varieties or untreated fields with prolonged exposure to favourable environmental conditions, such as high humidity, warm temperatures, and dense canopy cover. At this stage, the pathogen has extensively colonized both external and internal plant tissues, leading to profound physiological and structural damage. The resulting symptoms not only compromise plant health but also contribute to significant economic losses due to reduced cane weight, stunted growth, and poor juice quality. The key symptoms associated with this stage are as follows:

A. Yellowing and wilting of open stalk

Yellowing and wilting of the sugarcane open stalk is a symptom that occurs during the moderate to severe stages of Pokkah boeng, especially when the pathogen reaches internal tissues. The apical portion of the cane stalk (the shoot where leaves emerge) begins to turn yellowish. The discoloration starts at the youngest internodes, usually just below the spindle. Yellowing may progress downward, affecting a few upper internodes. This stage reflects a serious disruption of water and nutrient transport within the cane.

B. Knife cut Symptom

The knife cut symptom is the advanced stage associated with top rot phase. At this stage, one or more transverse cuts appear on the rind of the stalk, as if the stem tissue was sliced off cleanly by a sharp knife. This symptom significantly weakens the structural integrity of the cane, making it prone to lodging or breaking under field conditions.

3.2 Signs of Pokkah boeng disease

Pokkah boeng disease in sugarcane is characterized by distinct signs, among which whitish mycelial growth is one of the most notable. This whitish appearance results from the development of cottony, thread-like structures called hyphae, which are produced by the fungal pathogen responsible for the disease. These hyphae form the vegetative part of the mycelium, which actively colonizes the plant tissues. The fungal mycelium penetrates the sugarcane's epidermal and cortical regions, facilitating

systemic infection. This colonization disrupts normal physiological functions of the plant, leading to tissue softening, distortion and necrosis. In advanced stages, this mycelial growth may be visible on infected plant surfaces, especially in humid conditions and is often accompanied by a foul odour and tissue discoloration. The presence of such fungal signs is critical for early detection and accurate diagnosis of the disease, which is essential for timely management interventions.



Fig 1: Chlorosis or whitish streaks and stripes



Fig 2: Twisting of spindle leaf



Fig 3: Curling of spindle leaf

**Fig 4:** Tearing of leaves**Fig 6:** Reddening of leaf**Fig 5:** Top rot symptom**Fig 7:** Yellowing and wilting of open stalk**Fig 8:** Knife cut symptom

3.3 Screening of sugarcane genotypes against Pokkah boeng disease under natural field conditions

Host plant resistance is considered one of the most effective, economical, and environmentally sustainable strategies in integrated disease management. It refers to the inherent ability of a plant genotype to resist or tolerate pathogen attack, thereby minimizing yield losses without extensive chemical input. In sugarcane breeding and crop improvement programs, identifying resistant genotypes is crucial for both direct varietal release and as valuable genetic resources for hybridization. In present study, thirteen genotypes along with eight standard checks were evaluated against the Pokkah boeng disease under natural

field conditions during season 2024-2025 at Central Sugarcane Research Station, Padegoan. The genotypes were classified in to 4 categories based on their response to disease mentioned below. Accordingly, genotypes were grouped under different disease reaction categories based on 0-4 scale suggested by AICRP 2021 (Anonymous, 2021). Out of the 21 genotypes tested against Pokkah boeng disease, CoM 23001, CoM 23002, CoM 23007, CoM 23008, CoM 23009, CoM 23010, CoM 23011, CoM 23012, CoM 23013, Co VSI 08005, CoM 15012, CoM 0625, Co 86032, Co 7219, Co 7527 are found to be resistant to Pokkah boeng disease of sugarcane, whereas CoM 23003 are found to be moderately susceptible, CoM 23004, CoM

23005 and CoM 23006 are found to be susceptible and Co 99004 are found to be highly susceptible. Thus, the resistant varieties can be recommended for farmers and also for the scientific community for improving the breeding programme. Similar results were observed by Wang *et al.*, (2017) ^[9] and Viswakarma *et al.*, (2013) ^[8], they screened

twenty two sugarcane genotypes. Out of this, varieties BO139, CoP9301, Co 1148, BO91 etc. were found to be resistant, BO156, BO155, CoP11438 were observed moderately susceptible and the varieties Co 1148, BO130 were found susceptible to Pokkah boeng disease.

Table 2: Evaluation of sugarcane entries from advance genotypes against Pokkah boeng disease of sugarcane

Sr. No.	Genotypes	Mean% disease incidence	Reaction
1	CoM 23001	4.44	R
2	CoM 23002	4.6	R
3	CoM 23003	6.62	MS
4	CoM 23004	11.8	S
5	CoM 23005	13.03	S
6	CoM 23006	15.25	S
7	CoM 23007	0.00	R
8	CoM 23008	0.00	R
9	CoM 23009	0.00	R
10	CoM 23010	0.00	R
11	CoM 23011	0.00	R
12	CoM 23012	0.00	R
13	CoM 23013	0.00	R
14	Co VSI 08005©	1.22	R
15	CoM 15012©	1.53	R
16	Co 0265©	2.66	R
17	Co 86032©	2.88	R
18	Co 740©	3.33	R
19	Co 7219©	2.11	R
20	Co 7527©	0.00	R
21	Co 99004	38.41	HS

Table 3: Reactions of Sugarcane entries from advance genotypes against Pokkah boeng disease of sugarcane

Sr. No.	Description	Disease reaction	Total genotypes	Name of genotypes
1	0-5%	Resistant	16	CoM 23001, CoM 23002, CoM 23008, CoM 23009, CoM 23010, CoM 23011, CoM 23012, CoM 013, Co VSI 08005, CoM 15102, CoM 0265, Co 86032, Co 7219, Co 7527
2	5-10%	Moderately Susceptible	1	CoM 23003
3	10-20%	Susceptible	3	CoM 23004, CoM 23005 and CoM 23006
4	>20%	Highly Susceptible	1	Co 99004

4. Conclusion

The present study highlights the emerging threat of Pokkah boeng disease in sugarcane which is incited by *Fusarium moniliformae* is becoming serious and devastative disease in states like Maharashtra and it is shifting from minor disease to major one of economic concern. Pokkah boeng disease was found to predominantly manifest during the mid-growth phase of the crop, especially between 3 to 7 months of age and during the monsoon season and spreads through rain, wind, and insect vectors. Based on incidence and progression, the symptoms were effectively categorized into mild, moderate, and severe, providing a clear framework for field-level diagnosis and disease staging. Out of thirteen genotypes along with 8 checks evaluated against Pokkah boeng disease, 16 genotypes, viz., CoM 23001, CoM 23002, CoM 23007, CoM 23008, CoM 23009, CoM 23010, CoM 23011, CoM 23012, CoM 23013, Co VSI 08005, CoM 15102, CoM 0265, Co 86032, Co 740, Co 7219 and Co 7527 were found resistant reaction against Pokkah boeng disease under natural field conditions which provides valuable genetic material for future breeding programs and development of improved cultivars with enhanced disease resistance.

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