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SURVEY ON NATURAL INCIDENCE ACROSS MAJOR CANE GROWING BELTS OF BIHAR AND RESPONSE OF VARIETIES THROUGH ARTIFICIAL METHOD AGAINST POKKAH BOENG DISEASE

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ABSTRACT

Among the various diseases affecting sugarcane, Pokkah boeng, caused by *Fusarium proliferatum*, is of particular concern due to the economic losses it inflicts on both cane growers and the sugar industry. A survey conducted in 2022-23 planting season across different sugarcane-growing regions of Bihar, the average incidence of Pokkah boeng was highest in the Hasanpur sugar factory region (10.47%), followed by Manjhaulia (9.34%), Bagha (8.89%), Harinagar (8.75%), Gopalganj (8.67%), Sidhawalia (8.65%), Narkatiyaganj (8.13%), Sugauli (7.37%), and Kalyanpur (6.1%), all showing moderate disease severity, while the lowest incidence was observed at Pusa Research Farm (5.91%). The results indicated a wide variation in disease incidence, with Co 0238, CoSe 01421 showing the highest levels of infection. Across all trials and sugar mills, the overall incidence ranged from 2.17% to 18.27%, with an average incidence in the range of 5.91% to 10.47%. Field and pot trials were conducted to assess resistance levels against *Fusarium proliferatum* in 25 sugarcane varieties, including a check. Of these, 19 were early maturity and 6 were mid-late maturity varieties. Early maturity varieties showed higher susceptibility compared to mid-late types. Under field conditions, 36% of genotypes were resistant, 28% moderately susceptible, 28% susceptible, and 8% highly susceptible. In pot conditions, 24% were resistant, 24% moderately susceptible, 32% susceptible, and 20% highly susceptible. Overall, disease incidence was higher under pot conditions compared to field conditions. These findings emphasize the need for vigilant disease monitoring, evaluation of suitable variety and the implementation of integrated management practices to reduce the impact of Pokkah boeng on sugarcane productivity.

Keywords: Sugarcane, Survey, Evaluation, Pokkah boeng, *Fusarium proliferatum,* Disease incidence

Introduction

Sugarcane (*Saccharum officinarum* L.) from the family Poaceae has been traditionally cultivated for centuries in many Asian countries for producing sweeteners and direct consumption. It is an essential agro-industrial crop, propagated vegetatively in tropical and subtropical regions, and serves as raw material for the production of white sugar, jaggery, khandsari, and other by-products (Minnatullah *et al*., 2023). It is susceptible to various pathogens, leading to an estimated 10-25% yield loss. Among these, Pokkah boeng disease, caused by the fungal air-borne pathogen *Fusarium proliferatum*, was first described in Java, by Walker and Went in 1896, derives its name from the Javanese term for 'malformed top' (Martin, 1989). The disease progresses through four phases: chlorotic phase I, chlorotic phase II, acute or top rot phase, and knife

cut phase (Tiwari *et al*., 2020). Infection leads to crumpled, twisted leaves with malformations, impacting yield and juice quality (Whittle and Irawan, 2000; Govender *et al*., 2010). In India this disease was first reported in India from Maharashtra during 1983-84, affecting varieties Co 7219 and Co 671 (Patil and Hapse, 1987).

The disease causes significant economic losses for cane growers and the sugar industry by adversely impacting the number of green leaves, internodes, stalk girth, cane yield, and juice quality (Ranjan *et al*., 2018). The disease is exacerbated during the rainy season (July-August), with high relative humidity and temperatures promoting its development (Viswanathan and Padmanaban, 2008). It typically appears before the monsoon season and can affect crop growth, causing 10-38% yield losses in the susceptible POJ 2878 variety (Ricaud *et al*., 2012). Sugarcane plants aged three to seven months are particularly susceptible to Pokkah boeng disease, more so than older plants (Siddique, 2007). In Bihar, plants aged 4-5 months are most vulnerable (Ranjan *et al*., 2018). Singh *et al*. (2006) noted 0.1 to 10% incidence of Pokkah boeng in the subtropical region, with varieties CoS 8436 and CoS 88230 showing maximum incidence and reduced cane parameters. Disease incidence ranges from 1 to 90% in variety S 224/20 and 5 to 30% in CoSe 01434 (Vishwakarma *et al*., 2013). Recently, Pokkah boeng has become a major constraint in sugarcane production and has emerged as a predominant disease in China (Wang *et al*., 2016). Although Pokkah boeng classified as a minor disease, it has recently emerged as a major concern in Bihar. An extensive survey conducted during 2016–17 and 2017–18 across various sugarcane-growing regions of Bihar revealed that the disease is now prevalent in most cultivated varieties. The incidence of Pokkah boeng ranged from 2.0% to 26.5% in the reserved areas under sugarcane cultivation. The lowest incidence (2.0%) was recorded in varieties BO 153 and Rajendra Ganna-1, indicating their relative resistance. In contrast, varieties such as CoSe 95422, CoBln 15501, CoBln 14502, and CoSe 92423 were found to be susceptible to the disease, particularly in the Pusa region (Minnatullah *et al*., 2019). In Bihar, a mild to moderate incidence of the disease was reported across multiple sugarcane varieties. In western Uttar Pradesh specifically in the districts of Saharanpur, Muzaffarnagar, Meerut, and Bijnor the disease was found affecting various varieties (Vishwanathan *et al*, 2017). In Bihar, the disease has been reported in a moderate to severe form across nearly all cane-growing regions, affecting several commercial cultivars with incidence varying from trace to 20% in different areas (Minnatullah and Singh, 2021; Minnatullah *et al*., 2022). Recently, increasing trends of Pokkah boeng disease caused by (*Fusarium proliferatum*) incidence were noticed in most of the sugarcane varieties grown in Bihar which ranged between 5-15% (Minnatullah *et al*., 2023).

Cultivating resistant varieties is a key strategy for managing crop diseases and enhancing productivity. Screening and identifying resistant varieties is essential, as many commercial sugarcane varieties lack broad disease tolerance. Chemical control is often ineffective and poses health and environmental risks. Therefore, evaluating sugarcane genotypes against the Pokkah boeng pathogen is crucial for varietal development programs. Sharma and Kumar (2015) tested 12 isolates of *Fusarium moniliforme* on six sugarcane differentials, observing 4 isolates as susceptible/highly susceptible and the rest as resistant or moderately resistant. Wang *et al*. (2017) evaluated sugarcane clones against Pokkah boeng disease and reported 11 varieties as moderately to highly resistant. Sanghera *et al*. (2018) screened 72 clones/varieties, finding 44 resistants (<5% infection), 19 moderately susceptible (5.1–10%), 8 susceptible (10.1–20%), and 1 variety (Co 0238) highly susceptible (>20% infection). Ranjan *et al*. (2018) screened 22 varieties under natural conditions, identifying 12 as resistant, 4 as moderately susceptible, 4 as susceptible, and 2 as highly susceptible. Porika *et al*. (2020) assessed 10 promising clones in the field; 3 clones showed resistance, 1 was moderately resistant (10% infection), 4 were susceptible (10.1–20% infection), and 2 were highly susceptible (>20% infection).

Materials and Method

Survey

A systematic field survey was conducted during the 2022–2023 growing season to assess the incidence of Pokkah boeng disease in sugarcane. The survey covered various locations, including departmental fields of the Sugarcane Research Farm, Kalyanpur, and multiple sugar mill zones across Bihar. The specific survey sites included Hasanpur (Samastipur district), Harinagar, Narkatiyaganj, Manjhaulia, and Lauriya (West Champaran district), Sugauli (East Champaran district), and Sidhawalia and Gopalganj (Gopalganj district).

At each location, ten sugarcane plots were randomly selected for observation. Within each plot, four different spots were assessed, and a total of 100 canes were randomly selected and examined for the presence of disease symptoms.

Disease incidence

Visual observations were made to record the characteristic symptoms of Pokkah boeng disease (Figure 1), which included yellowing of leaves, top rot, ladder-like lesions, and the knife-cut phase. The presence and intensity of symptoms were reported, and the disease incidence percentage was calculated at each site.

The disease incidence (%) was computed using the following formula:

$$\text{Disease incidence (\%)} = \frac{\text{Number of affected canes}}{\text{Total number of canes assessed}} \times 100$$

Evaluation

A mixture of 250 g half-broken maize seeds, 750 g sand (1:3 ratio), and 100 ml distilled water was prepared. 100 g of this mixture was placed in 250 ml conical flasks, sterilized at 15 lb psi for 2 hours. After 4 days, each flask was inoculated with 4–5 mycelial discs of *Fusarium proliferatum* grown on oat meal agar and incubated at 25±1°C in BOD for 15 days. On the 16th day, the inoculum was combined, mixed thoroughly, and applied in furrows at 100 g/meter row, 7 days before planting. Setts were then planted and covered with soil.

Evaluation of Sugarcane Genotypes against *Fusarium proliferatum* three-budded setts of sugarcane genotypes (early and mid-late maturity), including a susceptible control, were planted in three replications for both field and pot studies. Disease resistance was assessed based on chlorosis, top rot, and knife-cut symptoms.

Disease Status

The status of Pokkah boeng disease was categorized into three levels mild, moderate, and severe based on the severity of visible symptoms observed on the sugarcane plants during the field survey. The classification criteria were as follows:

Mild Infection: Green plants exhibiting early symptoms such as curling or twisting of spindle leaves, tearing of leaf lamina, and the appearance of whitish to chlorotic streaks on the leaves at varying intensities.

Moderate Infection: Pronounced yellowing of the third or fourth leaf, often followed by complete chlorosis of the foliage and the onset of top rot symptoms.

Severe Infection: A combination of symptoms including leaf yellowing, discoloration (lightening) of stalks, and visible wilting symptoms in opened stalks.

Disease Incidence (%)	Infection Status
0–10%	Mild
>10–20%	Moderate
>20%	Severe

The varieties were categorized as per AICRP on Sugarcane disease rating scale:

Pokkah boeng disease rating scale on 0 to 30

Disease Incidence (%)	Reaction Rating
0–5%	Resistant
>5–10%	Moderately Susceptible
>10–20%	Susceptible
>20%	Highly Susceptible

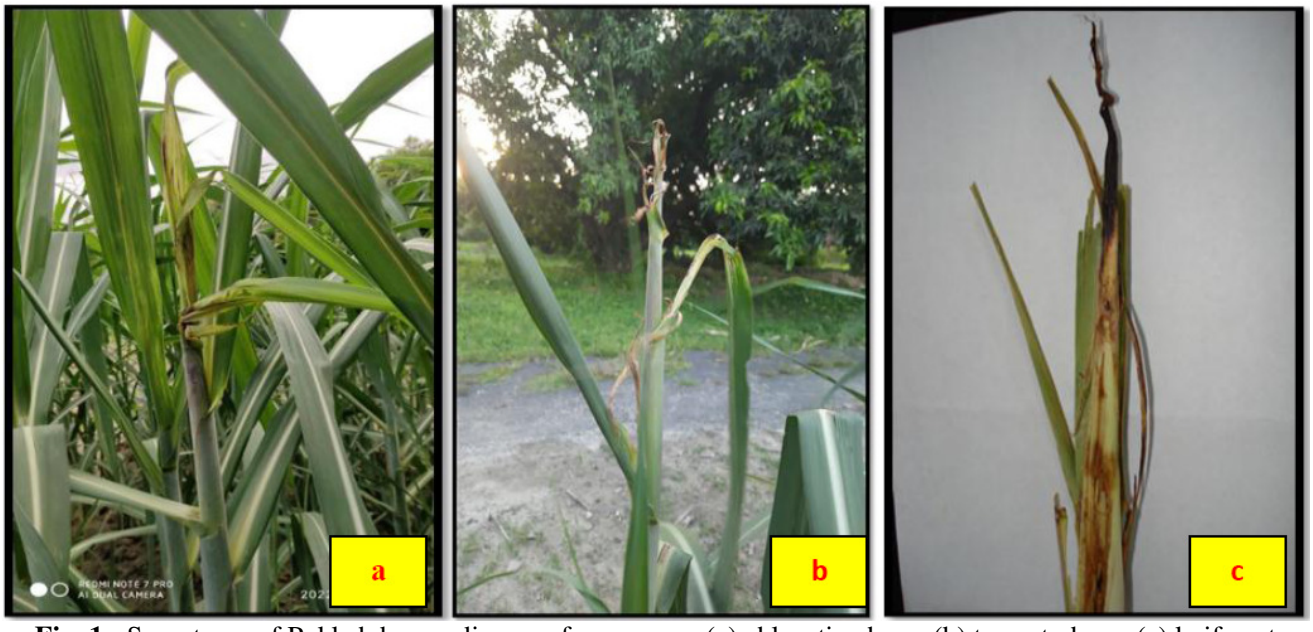


Fig. 1 : Symptoms of Pokkah boeng disease of sugarcane. (a) chlorotic phase; (b) top rot phase; (c) knife cut phase

Result

The Pokkah boeng disease incidence percentage and disease status were observed during the survey in Pusa and Kalyanpur farm as depicted in Table 1 and Figure 2 and also on Bihar map. In Pusa farm, it was noticed that Pokkah boeng disease was noticed to infect ten sugarcane varieties, with the variety CoSe 95422 having the highest disease incidence (12.6%) in the severe form and the variety Rajendra Ganna 3 having the lowest disease incidence (3.1%) in mild form. The average incidence of Pokkah boeng disease in Pusa trials was 5.91%, indicating a moderately susceptible disease status.

At Kalyanpur Research Farm, Pokkah boeng disease incidence percentage and disease status of various experimental plots were noted. In pathological experiments, the Pokkah boeng incidence was recorded on sixteen sugarcane cultivars, with the variety Co 0238 having the highest disease incidence (18.27%) in a severe form and the variety CoP 9301 having the lowest disease incidence (2.73%) in a mild form. The average incidence of Pokkah boeng disease in pathological trials was 7.49 %, indicating a moderately susceptible Pokkah boeng disease status. In experimental plot of entomology, Pokkah boeng disease incidence was recorded on seven sugarcane varieties, the variety CoP 18436 having the highest disease incidence (7.62%) in the severe form and the variety Rajendra Ganna I having the lowest disease incidence (3.65%) in mild form. The average incidence of Pokkah boeng disease in entomological trials was 5.67 %, indicating a moderately susceptible disease status. In breeding experimental plots, Pokkah boeng disease was recorded to infect twelve sugarcane varieties, the variety CoSe 01421 having the highest disease incidence (12.68%) in the severe form and the variety Rajendra Ganna 3 having the lowest disease incidence (2.82%) in the mild form. The average incidence of Pokkah boeng in breeding trials was 6.26 %, indicating a moderately susceptible Pokkah boeng disease status. In agronomy, the disease incidence was observed to infect six sugarcane varieties, the variety CoP 06436 having the highest disease incidence (8.62%) in severe form and the variety Rajendra Ganna 3 having the lowest disease incidence (2.31%) in the mild form. The average incidence of Pokkah boeng in agronomy trials was 5.25 %, indicating a moderately susceptible disease status. In soil science trials, the disease was noticed to infect six sugarcane varieties, the variety BO 154 having the highest disease incidence (8.38%) and the variety CoP 9301 having the least disease incidence (4.26%) in mild form. The average incidence of Pokkah boeng disease in soil science trials was 5.85 %, indicating a moderately susceptible disease status. Among different trials at Kalyanpur Research farm, the average highest sugarcane Pokkah boeng disease incidence (7.49%) in moderately susceptible form was observed in Pathological trials and the least sugarcane Pokkah boeng disease incidence (5.25%) in mild form was observed in Agronomy trials. The mean incidence of Pokkah boeng disease at Kalyanpur Research Farm was 6.1%, indicating a moderately susceptible Pokkah boeng disease status.

Among different trials at Kalyanpur Research farm, the average highest sugarcane Pokkah boeng disease incidence (7.49%) in moderately susceptible form was observed in Pathological trials and the least sugarcane Pokkah boeng disease incidence (5.25%) in mild form was observed in Agronomy trials. The mean incidence of Pokkah boeng disease at Kalyanpur Research Farm was 6.1%, indicating a moderately susceptible Pokkah boeng disease status.

The Pokkah boeng disease incidence percentage and disease status were also observed during the survey in different sugar mills as depicted in Table 2 and Figure 2 and also on Bihar map. In Hasanpur Sugar Mill reserved area, twelve sugarcane varieties were found affected with Pokkah boeng disease, the variety Co 0238 showed the highest disease incidence (16.42%) in a severe form and the variety CoLk 14201 showed the lowest disease incidence (6.92%). The mean incidence of Pokkah boeng disease at Hasanpur was 10.47% showing susceptible Pokkah boeng disease status.

In Harinagar Sugar Mill, eight sugarcane varieties were suffered due to Pokkah boeng disease, the variety Co Pant 97222 showed the highest disease incidence (11.72%) in a severe form and the variety Rajendra Ganna 1 showed the lowest disease incidence (4.62%) in a mild form. The mean incidence of Pokkah boeng disease at Harinagar was (8.75%) showing moderately susceptible disease status.

In Narkatiyaganj Sugar Mill, eleven sugarcane varieties were recorded to affected by the Pokkah boeng disease, the variety Co 0238 showed the highest disease incidence (13.12%) in a severe form and the variety CoP 9301 showed the least disease incidence (4.62%) in a mild form. The mean incidence of Pokkah boeng disease at Narkatiyaganj was 8.13% showing moderately susceptible disease status.

In Manjhaulia Sugar Mill, nine sugarcane varieties were found to be infected by the Pokkah

boeng disease, the variety CoH 167 showing the highest disease incidence (14.59%) in a severe form and the variety CoP 9301 showed the lowest disease incidence (4.29%) in a mild form. The mean incidence of Pokkah boeng disease at Manjhaulia was 9.34% showing moderately susceptible Pokkah boeng disease status.

In Bagha Sugar Mill reserved areas, out of seven varities the variety Co 0238 showed the highest disease incidence (14.67%) in a severe form and the variety CoP 9301 showed the lowest disease incidence (5.12%) in a mild form. The mean incidence of Pokkah boeng disease at Bagha was 8.89% showing moderately susceptible Pokkah boeng disease status.

Under Sugauli Sugar mill, seven sugarcane varieties were affected with Pokkah boeng disease in variety Co 0238 showing the highest disease incidence (17.53%) in a severe form whereas, in variety BO 153 the least disease incidence was noticed (2.17%) in a mild form. The mean incidence of disease at Sugauli was 7.37% showing moderately susceptible Pokkah boeng disease status.

In Sidhawalia Sugar Mill, nine sugarcane varieties were observed affected with Pokkah boeng disease, variety Co 0238 which was highest disease incidence (13.24%) in a severe form and the variety CoP 9301 showing the least disease incidence (5.24%) in a mild form. The mean incidence of Pokkah boeng disease at Sidhwalia was 8.65% showing moderately susceptible Pokkah boeng disease status.

In Gopalganj Sugar Mill, ten sugarcane varieties were succumbed with the Pokkah boeng disease in the variety Co 0238 showing the highest disease incidence (16.29%) in a severe form and the variety Co 15023 showing the lowest disease incidence (4.51%) in a mild form. The mean incidence of Pokkah boeng disease at Gopalganj was 8.67% showing moderately susceptible Pokkah boeng disease status.

For the evaluation of 25 sugarcane genotypes, including one check variety (CoSe 95422), against *Fusarium proliferatum* causing Pokkah boeng disease, genotypes were tested under both field and pot conditions as depicted in table 3 and figure 3. In the field condition, nine genotypes CoP 18438, CoP 18437, CoP 19440, BO 91, CoP 9301, CoP 17441, CoP 19441, CoP 20438, and CoSe 17452 showed a resistant reaction. Seven genotypes CoP 19439, CoP 06436, CoP 20437, CoLk 94184, CoP 20439, CoP 17438, and CoP 16454 were moderately susceptible. Another seven genotypes CoP 18436, CoSe 18451, CoSe 18452, CoSe 01421, CoP 20436, CoBln 17501, and CoSe 17451 were susceptible, while two genotypes, CoBln 17502 and CoSe 95422 (check), showed a highly susceptible reaction. Overall, 36% of the genotypes exhibited resistance, 28% were moderately susceptible, 28% were susceptible, and 8% were highly susceptible (Table 4, Figure 4).

Under pot conditions as depicted in table 5 and figure 5, six genotypes CoP 18437, CoP 19440, BO 91, CoP 9301, CoP 17441, and CoP 19441 were found to be resistant. Six genotypes CoP 18438, CoP 19439, CoP 06436, CoP 20437, CoP 20439, and CoSe 17452 were moderately susceptible. Eight genotypes CoP 18436, CoSe 18452, CoSe 01421, CoP 20438, CoP 20436, CoP 17438, CoP 16454, and CoLk 94184 were susceptible, whereas five genotypes CoSe 18451, CoBln 17501, CoBln 17502, CoSe 17451, and CoSe 95422 (check) were highly susceptible. The percentage distribution under pot conditions revealed that 24% of the genotypes were resistant, 24% moderately susceptible, 32% susceptible, and 20% highly susceptible (Table 6, Figure 6).

A total of 25 sugarcane genotypes, comprising 19 early and 6 mid-late maturing types, were evaluated for their response to *Fusarium proliferatum* under both field and pot conditions. The results revealed that early maturing genotypes were generally more susceptible to Pokkah boeng disease compared to mid-late maturing genotypes in both environments. Additionally, disease incidence was higher under pot conditions, where genotypes tended to show greater susceptibility than in the field. Notably, two genotypes (CoP 18438 and CoSe 17452) that were resistant in the field became moderately susceptible in pots. Three genotypes (CoP 17438, CoP 20438, and CoSe 16454), initially graded as moderately susceptible in the field, showed susceptible reactions in pots. Furthermore, three genotypes (CoBln 17501, CoSe 18451, and CoSe 17451), which were susceptible in the field, shifted to a highly susceptible reaction under pot conditions.

Discussion

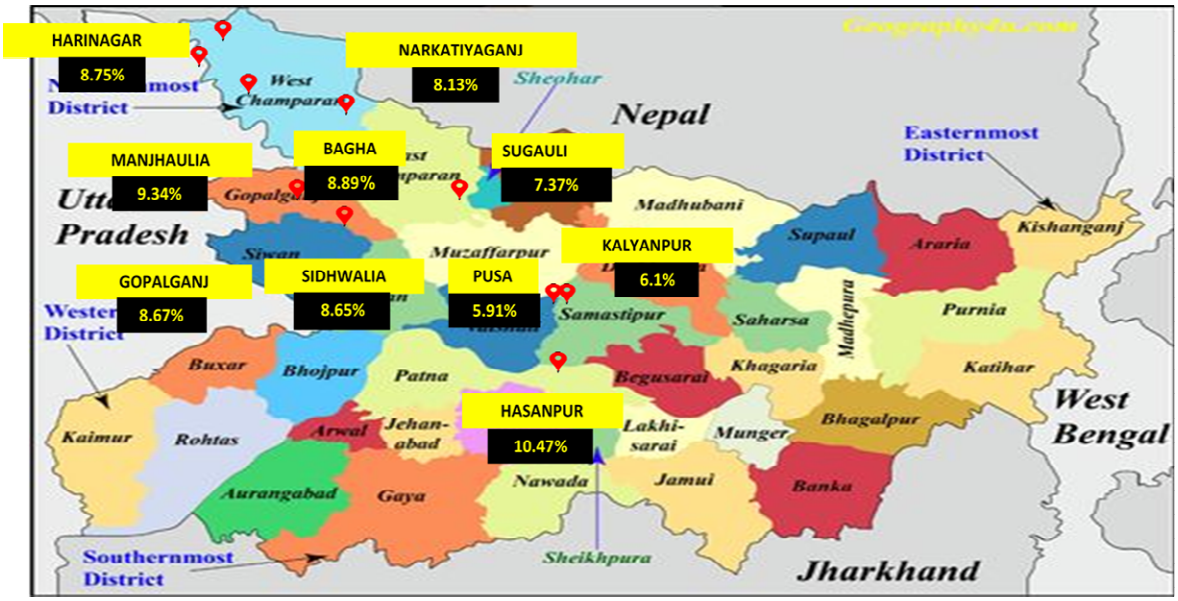
A comprehensive survey of sugarcane Pokkah boeng disease across various cane-growing regions in Bihar was conducted, covering ten different locations. The survey aimed to identify the sugarcane varieties affected by the disease, measure its incidence percentage, and assess its overall status. Among all the areas surveyed, the Hasanpur sugar factory region had the highest average incidence of Pokkah boeng disease (10.47%) in severe form, followed by Manjhaulia (9.34%), Bagha (8.89%), Harinagar (8.75%), Gopalganj (8.67%), Sidhawalia (8.65%), Narkatiyaganj (8.13%), Sugauli (7.37%), and Kalyanpur (6.1%), all showing moderate disease

severity. The lowest average incidence was observed in Pusa, Samastipur district (5.91%), also in moderate form. A survey in North Bihar's sugarcane reserved areas during the 2017-18 season found Pokkah boeng disease incidence ranging from 1.1% to 21.2% across various localities (Ranjan *et al*., 2018). Similar findings were reported by Minnatullah *et al*. (2022), who observed Pokkah boeng disease incidence ranging from trace to 20% across different cane-growing areas of Bihar. Karuppaiyan *et al*. (2015) also noted an incidence range of 6.9% to 25.3%. Duttamajumdar (2004) also observed that incidence of Pokkah boeng disease from trace to moderate level on most of the commercial varieties.

Twenty-five sugarcane varieties, including one check (CoSe 95422), comprising 19 early and 6 mid-late maturing varieties, were evaluated against *Fusarium proliferatum*, the causal agent of Pokkah boeng disease. Under field conditions, 36% of the varieties were resistant, 28% moderately susceptible, 28% susceptible, and 8% highly susceptible. Early maturing varieties showed greater susceptibility compared to mid-late types. In pot conditions, 24% were resistant, 24% moderately susceptible, 32% susceptible, and 20% highly susceptible. Overall, disease incidence was higher in pots than in the field. These results align with findings by Ranjan *et al*. (2018), who reported 12 resistant, 4 moderately susceptible, 4 susceptible, and 2 highly susceptible varieties among 22 tested. Similar resistance patterns were also noted by Wang *et al*. (2017) and Vishwakarma *et al*. (2013).

Conclusion

The survey conducted in Pusa Farm, Kalyanpur Research Farm, and various sugar mills revealed that Pokkah boeng disease is widespread across several sugarcane varieties. The highest disease incidence was recorded in the variety Co 0238, both in research farms and sugar mill areas, indicating its high susceptibility to the disease. Across all trials and sugar mills, the overall incidence ranged from 2.17% to 18.27%, with an average incidence in the range of 5.91% to 10.47%. The majority of varieties demonstrated a moderately susceptible status to Pokkah boeng disease, while certain varieties like CoSe 95422, Co 0238, and CoH 167 exhibited higher susceptibility, requiring targeted disease management practices. Higher infection rates were noted particularly in early maturing sugarcane varieties, emphasizing their greater susceptibility compared to mid-late types. The field and pot trials demonstrated that early maturing sugarcane varieties were more susceptible to *Fusarium proliferatum* compared to mid-late maturing types. This results underscore the importance of selecting resistant genotypes, particularly among early maturing varieties, to effectively manage Pokkah boeng disease and enhance sugarcane productivity. Overall, the findings highlight the need for continuous monitoring, careful selection of resistant varieties, and the adoption of integrated disease management strategies to mitigate the impact of Pokkah boeng disease on sugarcane production.



Map showing survey of sugarcane Pokkah boeng disease naturally occurring in different cane growing areas of Bihar

Table 1: Status of sugarcane Pokkah boeng disease naturally occurring in Pusa and Kalyanpur farm.

S.No.	Location	Varieties	Disease Incidence (%)	Disease Status
A	PUSA	Rajendra Ganna 1	5.6	MS
		CoSe 95422	12.6	S
		BO 153	4.2	R
		Rajendra Ganna 3	3.1	R
		Rajendra Ganna 4	4.2	R
		Rajendra Ganna 5	5.3	MS
		Rajendra Ganna 6	3.6	R
		Rajendra Ganna 7	4.5	R
		CoP 112	7.2	MS
		CoP 06436	8.8	MS
		Mean	**5.91**	
B	**KALYANPUR**			
1	Plant Pathology trials	Co 0238	18.27	S
		CoV 92102	13.11	S
		BO 153	3.27	R
		CoSe 95422	11.72	S
		CoP 06436	6.37	MS
		Rajendra Ganna I	4.21	R
		CoP 9301	2.73	R
		CoSe 01421	16.38	S
		CoP 18438	4.27	R
		CoP 18437	3.72	R
		CoP 18436	5.17	MS
		CoP 17438	7.83	MS
		CoP 17436	8.21	MS
		CoP 17440	6.16	MS
		CoP 17439	4.59	R
		CoP 20436	3.92	R
		Mean	**7.49**	
2	Entomology trials	CoP 06436	7.24	MS
		BO153	4.16	R
		Rajendra Ganna I	3.65	R
		CoP 18436	7.62	MS
		CoP 19439	6.7	MS
		CoP 20436	4.23	R
		CoP 19440	6.12	MS
		Mean	**5.67**	
3	Breeding & Genetics trials	CoP 18436	6.47	MS
		CoP 18437	4.53	R
		CoP 18438	5.18	MS
		CoSe 01421	12.68	S
		CoLk 94184	10.47	S
		CoP 17436	7.26	MS
		Rajendra Ganna 1	4.42	R
		Rajendra Ganna 2	4.18	R
		Rajendra Ganna 3	2.82	R
		Rajendra Ganna 4	3.68	R
		Rajendra Ganna 5	5.26	MS
		CoP 06436	8.21	MS
		Mean	**6.26**	
4	Agronomy trials	CoP 20436	6.78	MS
		Rajendra Ganna 1	3.58	R
		Rajendra Ganna 3	2.31	R
		CoP 9301	3.52	R
		CoP 06436	8.62	MS

		CoP 112	6.71	MS
		Mean	**5.25**	
5	**Soil Science trials**	CoP 112	5.83	MS
		Rajendra Ganna I	4.67	R
		CoP 06436	7.67	MS
		CoP 9301	4.26	R
		BO 153	4.31	R
		BO154	8.38	MS
		Mean	**5.85**	
Pokkah boeng disease status at Kalyanpur farm			**6.1**	

Table 2: Status of Sugarcane Pokkah boeng disease in different locations of sugar mill of Bihar

S. No	Location	Varieties	Disease Incidence (%)	Disease Status	S.No	Location	Varieties	Disease Incidence (%)	Disease Status
C	**HASANPUR**	Rajendra Ganna 1	7.24	MS	**G**	**BAGHA**	Rajendra Ganna 1	5.53	MS
		Co 0238	16.42	S			Co 0118	8.43	MS
		Co Pant 97222	12.83	S			Co 0238	14.67	S
		CoP 06436	7.28	MS			CoP 9301	5.12	MS
		Co 0118	11.68	S			Co 15023	7.62	MS
		CoLk 14201	6.92	MS			CoS 13235	11.67	S
		Co 15023	9.67	MS			CoLk 14201	9.23	MS
		CoS 13235	13.71	S			**Mean**	**8.89**	
		CoS 8436	9.67	MS	**H**	**SUGAULI**	Rajendra Ganna1	4.73	R
		Co 12029	8.37	MS			Co 0238	17.53	S
		CoS 98231	13.62	S			Co 0118	11.67	S
		CoLK 94184	8.23	MS			CoP 9301	5.14	MS
		Mean	**10.47**				BO 153	2.17	R
D	**HARINAGAR**	Rajendra Ganna 1	4.62	R			CoP 112	3.59	R
		Co 0238	11.70	S			Co 15023	6.82	MS
		Co 0118	7.24	MS			**Mean**	**7.37**	
		CoLk 14201	8.73	MS	**I**	**SIDHAWALIA**	Rajendra Ganna 1	6.87	MS
		Co 06436	6.23	MS			CoP 9301	5.24	MS
		Co Pant 97222	11.72	S			Co 0118	8.81	MS
		Co 15023	8.91	MS			Co 0238	13.24	S
		CoS 8436	10.87	S			Co 15023	6.16	MS
		Mean	**8.75**				Co 15023	11.67	S
E	**NARKATIYAGANJ**	Rajendra Ganna 1	5.23	MS			CoP 06436	8.54	MS
		Co 0238	13.12	S			CoS 98231	10.11	S
		CoS 8436	7.67	MS			CoLk 94184	7.21	MS
		Co 15023	6.76	MS			**Mean**	**8.65**	
		CoLk 14201	5.67	MS	**J**	**GOPALGANJ**	Rajendra Ganna 1	6.12	MS
		CoS 13235	8.87	MS			Co 0118	9.15	MS
		Co 0118	9.27	MS			CoP 9301	6.26	MS
		CoLk 94184	7.68	MS			CoP 112	8.11	MS
		CoP 06436	8.92	MS			BO 154	9.24	MS
		Co 12029	11.71	S			Co 0238	16.29	S
		CoP 9301	4.62	R			Co Pant 97222	14.62	S
		Mean	8.13				Co 15023	4.51	R
F	**MANJHAULIA**	Rajendra Ganna 1	6.73	MS			Co 92006	6.12	MS
		CoS 8436	11.21	S			CoS 13235	6.29	MS
		Co 0118	9.71	MS			**Mean**	**8.67**	
		Co 12029	7.89	MS					
		Co 15023	8.73	MS					
		Co 0238	12.87	S					
		CoP 06436	8.12	MS					
		CoP 9301	4.29	R					
		CoH 167	14.59	S					
		Mean	**9.34**						

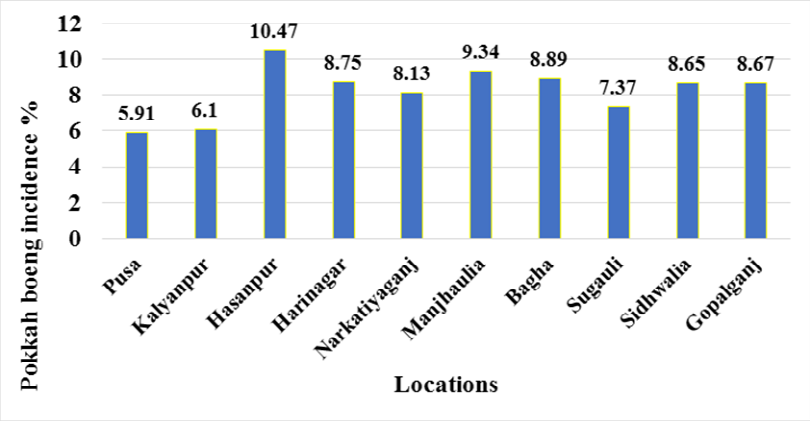


Fig. 2 : Survey of sugarcane Pokkah boeng disease naturally occurring in different cane growing areas of Bihar

Table 3 : Evaluation of sugarcane varieties against *Fusarium proliferatum* under field condition

S.No.	Varieties	Maturity Groups	Disease Score	Disease Reaction
1	CoP 18437	E	2.6	R
2	CoLk 94184	E	3.2	R
3	CoP 19440	ML	3.6	R
4	CoP 18438	E	4.2	R
5	BO 91	ML	4.2	R
6	CoSe 17452	E	4.2	R
7	CoP 19441	ML	4.4	R
8	CoP 9301	E	5.0	R
9	CoP 17441	E	5.0	R
10	CoP 19439	ML	7.6	MS
11	CoP 17438	E	7.9	MS
12	CoP 20438	E	8.2	MS
13	CoP 06436	ML	8.6	MS
14	CoP 16454	E	9.2	MS
15	CoP 20437	E	9.4	MS
16	CoP 20439	E	10.0	MS
17	CoP 18436	E	11.2	S
18	CoSe 17451	E	11.6	S
19	CoSe 18451	E	11.8	S
20	CoP 20436	E	12.3	S
21	CoSe 01421	E	12.7	S
22	CoSe 18452	E	13.2	S
23	CoBln 17501	E	13.7	S
24	CoBln 17502	ML	21.9	HS
25	CoSe 95422 (Check)	E	22.4	HS

R-Resistant, MS-Moderately Susceptible, S-Susceptible, HS-Highly Susceptible, E-Early, ML-Mid late

Table 4 : Percentage of varieties exhibiting distinct disease responses to *Fusarium proliferatum* under field conditions

S.No.	Rating score	Disease Reaction	Number of varieties	Percentage (%)
1	0.0-5.0	R (Resistant)	9	36
2	5.1-10.0	MS (Moderately Susceptible)	7	28
3	10.1-20.0	S (Susceptible)	7	28
4	20.1-30.0	HS (Highly Susceptible)	2	8

Table 5 : Evaluation of sugarcane varieties against *Fusarium proliferatum* under pot condition

S.No.	Varieties	Maturity Groups	Disease Score	Disease Reaction
1	CoP 18437	E	4.2	R
2	CoP 19441	ML	4.5	R
3	CoP 19440	ML	4.7	R
4	CoP 17441	E	4.9	R
5	CoP 9301	E	5.0	R
6	BO 91	ML	5.0	R
7	CoP 18438	E	8.4	MS
8	CoP 19439	ML	9.2	MS
9	CoP 06436	ML	9.6	MS
10	CoSe 17452	E	9.8	MS
11	CoP 20437	E	10.0	MS
12	CoP 20439	E	10.0	MS
13	CoP 18436	E	13.6	S
14	CoP 17438	E	14.1	S
15	CoP 20438	E	14.3	S
16	CoSe 01421	E	14.7	S
17	CoLk 94184	E	14.9	S
18	CoP 20436	E	15.4	S
19	CoSe 16454	E	15.8	S
20	CoSe 18452	E	16.5	S
21	CoBln 17501	E	21.2	HS
22	CoSe 18451	E	21.5	HS
23	CoSe 17451	E	22.9	HS
24	CoBln 17502	ML	27.6	HS
25	CoSe 95422 (Check)	E	28.4	HS

R-Resistant, MS-Moderately Susceptible, S-Susceptible, HS-Highly Susceptible, E-Early, ML-Mid late

Table 6 : Percentage of varieties exhibiting distinct disease responses to *Fusarium proliferatum* under pot conditions

S.No.	Rating score	Disease Reaction	Number of varieties	Percentage (%)
1	0.0-5.0	R (Resistant)	6	24
2	5.1-10.0	MS (Moderately Susceptible)	6	24
3	10.1-20.0	S (Susceptible)	8	32
4	20.1-30.0	HS (Highly Susceptible)	5	20

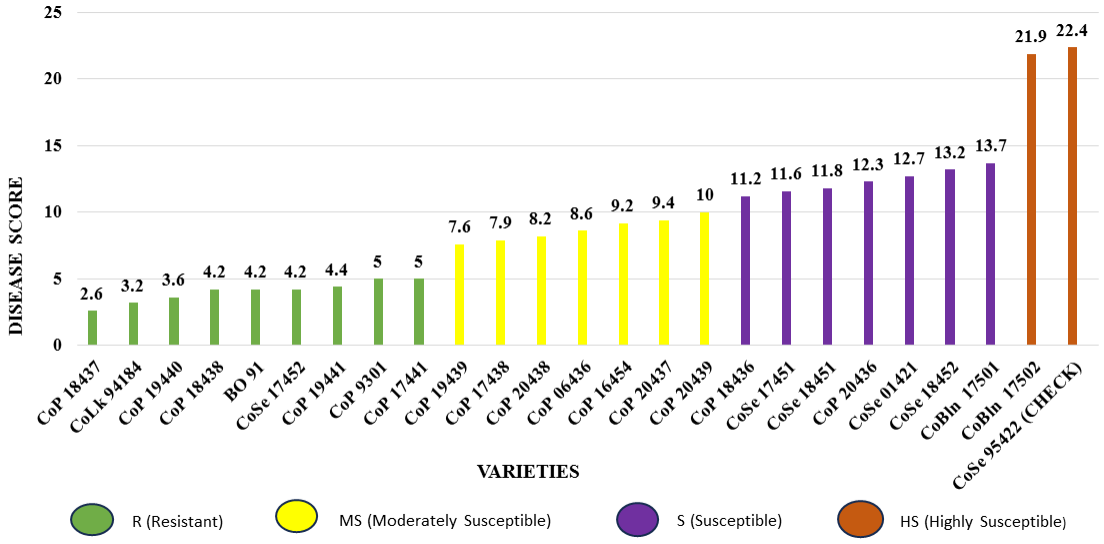


Fig. 3 : Evaluation of sugarcane varieties against *Fusarium proliferatum* under field condition

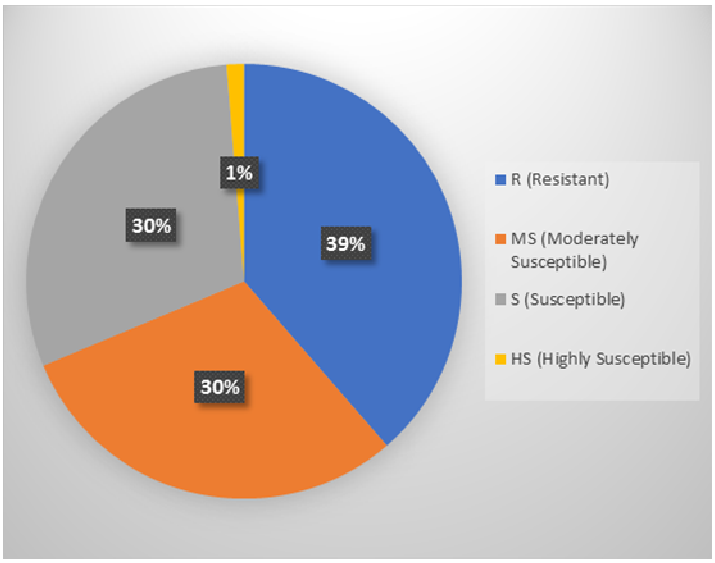


Fig. 4 : Percentage of varieties exhibiting distinct disease responses to *Fusarium proliferatum* under field conditions

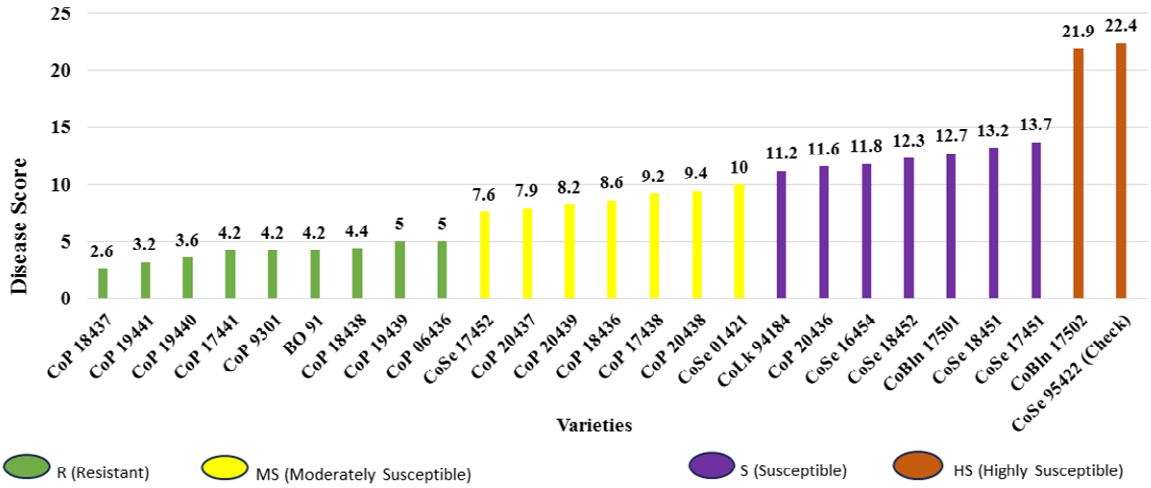


Fig. 5 : Evaluation of sugarcane varieties against *Fusarium proliferatum* under pot condition

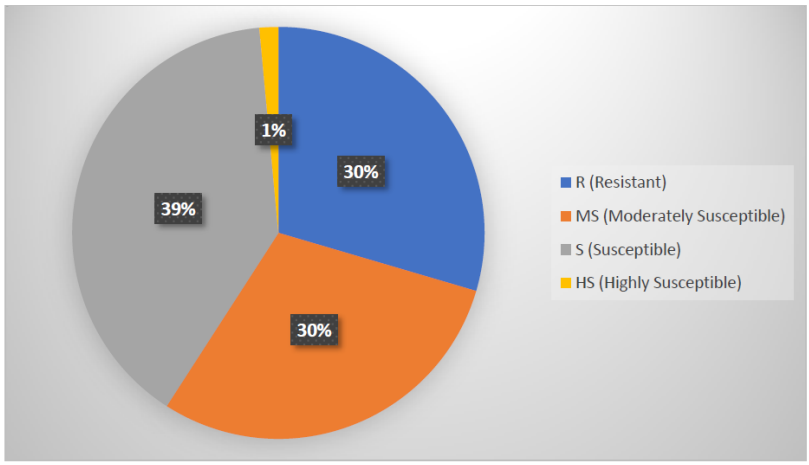


Fig. 6 : Percentage of varieties exhibiting disease responses against *Fusarium proliferatum* under pot conditions

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