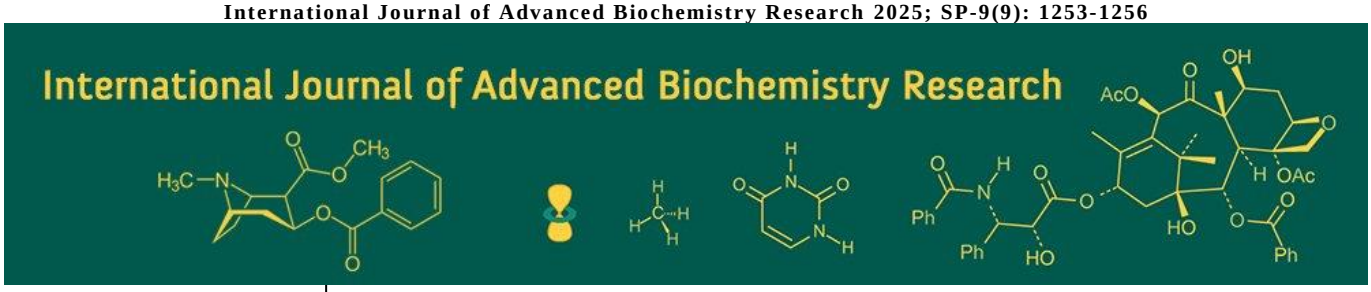

ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2025): 5.29
IJABR 2025; SP-9(9): 1253-1256
www.biochemjournal.com
Received: 02-07-2025
Accepted: 05-08-2025

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Evaluation of MPKV bioconsortia against Pokkah boeng disease of sugarcane

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DOI: https://www.doi.org/10.33545/26174693.2025.v9.i9Sp.5683

Abstract
Sugarcane (*Saccharum officinarum* L.) is an important C4 crop grown in tropical and subtropical regions for sugar, jaggery, ethanol, and other by products. In India, it is a key livelihood source, but its productivity is threatened by Pokkah boeng disease, caused by *Fusarium moniliforme*. The disease shows mild, moderate, and severe symptoms, making its management crucial. This study evaluated the efficacy of MPKV bioconsortia—a fungal and bacterial formulation—against Pokkah boeng disease. Eight treatments were tested, including bioformulations, a chemical check (Mancozeb), and control. Among them, T_6 (fungal + bacterial consortia @ 10 g/L) recorded the lowest disease incidence (10.65%) and maximum disease control (64.32%), surpassing Mancozeb (12.04%, 59.66%). T6 also improved growth traits such as internode length (14.71 cm), cane girth (11.41 cm), and yield attributes like cane weight (2.0 kg), cane yield (132.63 t/ha), and CCS yield (22.06 t/ha). Enhanced brix, sucrose, and purity further demonstrated the bio-stimulatory and disease-suppressive role of microbial consortia.

Keywords: Pokkah boeng, MPKV bioconsortia, *Fusarium moniliformae*, sugarcane

1. Introduction
Sugarcane (*Saccharum officinarum*) is the major C_4 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 genus *Saccharum* consists of hybrids that have been developed from *Saccharum officinarum*, *S. sinense*, *S. barberi*, and *S. spontaneum* (Zhang and Martin, 2018) [12]. Sugarcane is popularly called as noble cane because of wide range of biological effects including natural immunity against various infections that occur in humans. The sugarcane industry faces various hurdles and obstacles in increasing the productivity of sugarcane that includes floods, water logging, weed, disease and pests etc. Among these, disease cause severe reduction both in the quantity and quality of the cane production. Around 55 diseases have been reported in India out of which some are economically important caused direct and indirect damage to sugarcane production (Viswanathan and Rao, 2011) [10]. The fungal disease alone can reduce the yield up to 15-30% as an average estimate (Tiwari *et al*., 2010) [7]. But the epiphytic condition can cause yield loss up to 100% (Viswanathan and Rao, 2011) [10]. Among the organisms, fungus cause more damage than the others. The major fungal disease includes red rot of sugarcane (*Colletotrichum falcatum*), Smut disease of sugarcane (*Ustilago scitaminae*), Pineapple disease (*Ceratocystis Paradoxa*), wilt disease (*Cephalosporium sacchari*), Rust (*Puccinia sacchari*) *and* Pokkah boeng (*Fusarium moniliforme*).
Pokkah boeng disease which was considered as minor disease is becoming more significant in various regions. This disease has been recognized in sugarcane cultivation for a significant amount of time. Presently, reports of Pokkah boeng disease incidence and severity have emerged from major sugarcane-growing states such as Maharashtra, Punjab, Haryana, Assam, Tamil Nadu, and Bihar in India, as well as in other sugarcane growing countries. The pathogen spreads through wind-driven rain, infected cane cuttings, and through the pupae and adult stages of sugarcane stem borers. The disease spreads mostly emerge in grand growth stage under hot and humid conditions during abundant rainfall spanning from late spring to end of summer (Arya *et al*., 2017) [1].

The fungal pathogen of Pokkah boeng disease is *Fusarium moniliformae*, it belongs to the kingdom fungi, Phylum Ascomycota, Class-Sordariomycetes, Order-Hypocreales and Family-Nectriaceae, Genus-*Fusarium*, Species-*moniliformae*. The genus *Fusarium* contains around 20 species (Wang *et al*., 2011) [11]. The mycelium of *Fusarium moniliformae* 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) [5]. 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) [6].

The spraying of fungicides like bavistin, blitox, copper oxychloride was found to be effective against this disease but these raised significant animal and human health problems which emphasise alternative pathogen management strategies (Kamal and Singh, 1979) [2]. In view of important this disease in sugarcane cultivation a present investigation was carried out for knowing the symptoms the disease, to identify resistant sugarcane genotypes and its effective integrated management of the Pokkah boeng disease.

2. Materials and Methods

2.1 MPKV bioconsortia and fungicide

MPKV bioconsortia and fungicide given in Table 1 were purchased from Department of Plant Pathology and Agriculture Microbiology, Mahatma Phule Krishi Vidyapeeth, Rahuri and different manufacturers were used during the investigation.

List 1: Details of MPKV bioconsortia and fungicide used against Pokkha boeng disease

Sr. No.	Name of product	Chemical name	Source (Manufacturer)
1	Fungal consortium	Fungal inoculants	Department of Plant Pathology, MPKV, Rahuri
2	Bacterial consortium	Bacterial inoculants	
3	Fungal + Bacterial consortium	Fungal + Bacterial inoculants (Phule superbiomix)	
4	Mancozeb 75 WP	Mancozeb 75 WP	Adama Pvt. Ltd.

2.2 Effect of MPKV bioconsortia in management of Pokkah boeng disease of Sugarcane

A field experiment was conducted at research farm of Central Sugarcane Research Station, Padegaon during *Suru* season for the year 2024-25. An experiment was laid out in randomized block design with three replications and eight treatments. Twenty, two eye budded setts of susceptible variety Co 99004 were planted in five rows (row-row distance was 1.20 m) of six meter length by conventional method of planting. All the recommended agronomical package of practices was adopted for raising the crop.

Treatment Details

T_1: Fungal consortium @ 5 gm/lit
T_2: Fungal consortium @ 10 gm/lit
T_3: Bacterial consortium @ 5 gm/lit
T_4: Bacterial consortium @ 10 gm/lit
T_5: Fungal + bacterial consortium @ 5 gm/lit
T_6: Fungal + bacterial consortium @ 10 gm/lit
T_7: Mancozeb 75 WP @ 3 gm/lit
T_8: Untreated control

On the basis of percent disease incidence, genotypes were grouped into various categories. The rating scale given below is also followed in the All India Coordinated Research Project programme (AICRP, 2021) for testing sugarcane genotypes against pokkah boeng.

List 2: percent disease incidence and respective reaction

Sr. No.	Percent incidence	Disease reaction
1	0-5%	Resistant
2	5-10%	Moderately susceptible
3	10-20%	Susceptible
4	>20%	Highly susceptible

3. Results and Discussion

3.1 Effect of MPKV bioconsortia against the management of Pokkah boeng disease of sugarcane

The results of the effect of MPKV bioconsortia on percent disease incidence of Pokkah boeng disease of sugarcane is presented in Table 1. The results indicated that the Pokkah boeng disease ranged from 10.65 to 29.85 percent during period of experiment. The perusal of the data on percent disease incidence and percent disease control indicated that all the treatments were significantly superior in reducing Pokkah boeng disease over the untreated control. Among them, T_6-Foliar spray of fungal and bacterial consortium @ 10 g per litre was found significantly superior and the most effective for the control of Pokkah boeng disease of sugarcane. It recorded minimum disease incidence (10.65%). The next best treatments for reducing Pokkah boeng disease of disease of sugarcane in order of merit was T_7-Mancozeb 75 WP @ 3 gm per litre (12.04%) followed by T_5-Fungal + Bacterial consortium 5 g per litre (14.00%), T_4-Bacterial consortium @ 10 gm per litre (17.25%), T_2 Fungal consortium 10 gm per litre (18.47%), T_3-Bacterial consortium @ 5 g per litre (20.73%), T_1-Fungal consortium @ 5 gm per litre (25.12%), respectively.

Table 1: Effect of MPKV bioconsortia on mean percent disease incidence and percent disease control against Pokkah boeng disease of Sugarcane

Tr. No.	Treatments	Mean percent disease incidence	Percent disease control
T_1	Fungal consortium @ 5 g per litre.	25.12 (30.04)	15.85
T_2	Fungal consortium @ 10 g per litre.	18.47 (25.42)	38.12
T_3	Bacterial consortium @ 5 g per litre.	20.73 (27.00)	30.48
T_4	Bacterial consortium @ 10 g per litre.	17.25 (24.49)	42.21
T_5	Fungal + Bacterial consortium 5 g per litre	14.00 (21.95)	53.09
T_6	Fungal + Bacterial consortium 10 g per litre	10.65 (18.97)	64.32
T_7	Mancozeb 75 WP @ 3 gm/lit	12.04 (20.21)	59.66
T_8	Untreated Control	29.85 (32.92)	---
	S.E.(m)±	2.63	
	CD (5%)	7.98	
	CV (%)	24.53	

Table 2: Effect of MPKV bioconsortia on cane yield and quality parameters of sugarcane

Tr. No.	Treatments	No. of internode	Internode length	Cane girth (cm)	Single cane weight (kg)	NMC Per ha	Cane yield (t/ha)	CSS Yield (t/ha)	Brix (%)	Purity (%)	CSS (%)	Sucrose (%)
T_1	Fungal consortium @ 5 g per litre.	20.12	11.05	9.68	1.26	91.53	106.38	15.88	21.15	86.56	14.93	20.65
T_2	Fungal consortium @ 10 g per litre.	20.54	12.49	10.21	1.61	92.26	112.75	17.36	21.26	92.40	15.39	21.14
T_3	Bacterial consortium @ 5 g per litre.	20.14	11.57	9.71	1.37	90.90	110.15	16.92	21.25	89.35	15.36	21.11
T_4	Bacterial consortium @ 10 g per litre	20.95	13.52	10.26	1.68	94.46	116.54	18.03	21.43	93.02	15.47	21.26
T_5	Fungal + Bacterial consortium @ 5 g per litre	22.41	13.55	10.73	1.75	99.48	125.98	19.88	20.46	93.31	15.78	21.29
T_6	Fungal + Bacterial consortium 10 g per litre	24.48	14.71	11.41	2.00	102.9	132.63	22.06	21.88	95.40	16.63	22.52
T_7	Mancozeb 75 WP @ 3 gm/lit	23.11	14.16	11.22	1.79	101.39	129.92	21.22	21.83	94.08	16.33	22.21
T_8	Untreated Control	18.92	9.73	9.29	1.23	90.00	100.68	14.55	19.74	89.40	14.50	19.83
	SE (m) ±	1.09	0.99	0.44	0.08	1.95	3.85	0.59	0.24	1.12	0.55	0.29
	CD (5%)	3.33	3.02	1.35	0.25	5.93	11.69	1.81	0.736	3.42	1.92	0.89
	CV%	9.24	13.69	7.51	9.09	3.55	5.71	5.68	1.99	7.97	4.28	2.39

Vinale *et al*., (2008) [9] proved that *Trichoderma* shows various mechanisms like mycoparasitism, antibiosis, competition, to inhibit the growth of target pathogen and also imparts disease resistance in plants. Karuppaiyan *et al*., (2015) [3] proved that *Trichoderma* enhanced the plant's resistance to the disease by triggering its defense responses and improving overall plant vigour, which resulted in reduced disease incidence and increased yield. Lorito *et al*., (2010) [4] stated that *Trichoderma* has been extensively researched and commercially developed, and it is being used as bio-fungicides, bio-fertilizers, and soil amendments due to their effectiveness in protecting plants under adverse conditions. *Trichoderma* is naturally found in rhizosphere and phyllosphere, making it a powerful natural defence against harmful plant pathogens.

3.2 Effect of MPKV bioconsortia on cane yield and quality parameters of sugarcane

The data related to the effect of MPKV bioconsortia on cane yield and quality parameters were significantly influenced by different treatments and are presented in table 1. The cane girth, internode length and number of internodes were significantly influenced by different treatments. Among different treatments of sugarcane, T_6-Foliar spray of fungal and bacterial consortium @ 10 gm was found superior to the other treatments. This treatment recorded significantly maximum internode length (14.71 cm), cane girth (11.41 cm), No. of internodes (24.48/cane), single cane weight (2 kg), NMC (102.9/ha), CCS yield (22.06 t/ha) and cane yield (132.63 t/ha), CCS% (16.63%), Brix (21.88%), Purity (93.06%) sucrose content (22.52%), respectively. However, it was found statistically par with the treatment T_7-Foliar spray of Mancozeb 75 WP @ 3 g per litre and T_5-Foliar spray of Fungal and Bacterial consortium @ 5 g per litre in respect of internode length (14.16 cm) (13.55 cm), Cane girth (11.22 cm) (10.73 cm), number of internodes (23.11) (22.41), single cane weight (1.79) (1.75) NMC (101.39) (99.48) CSS yield (21.22) (19.88) respectively.

The above results are in line with the results of several researchers. Tiwari *et al*., (2021) [8] stated that the application *T. harzianum* showed the improvement in physical growth performance like sugarcane height, the number of tillers, cane length, single cane weight, the number of milliable canes, etc. Arya *et al*., (2017) [1] conducted an experiment with application of fungal and bacterial consortia against the pokkah boeng disease and they got increased yield (48.35kg/ha) and also significantly higher yields are obtained with all other treatments like *T. harzianum* Th14 (38.13 kg/plot), *Pseudomonas fluorescence* psf 02 (43.22 kg/plot), Fungicide (32.27 kg/plot) and control (28.80kg/plot) and also increase in other yield attributing factors which include cane weight, cane length, NMC etc. *Pseudomonas fluorescence* also proved to be successful biocontrol agent against this disease and the potential of

Bacillus spp. as biocontrol agent against plant pathogens have been discussed by various scientists (Korsten., *et al*. 2000) [13].

4. Conclusion

As far as disease management is concerned, three foliar sprays of MPKV bioconsortia @ 10 gm/lit immediately after appearance of disease at an interval of 15 days was found to be most effective in management of Pokkah boeng disease of sugarcane as compared to the rest of the treatments which recorded minimum percent disease incidence (10.65%) and highest 64.31 percent disease control against Pokkah boeng disease of sugarcane. However, it recorded highest single cane weight (2.00 kg), NMC (82,790/ha), CCS yield (22.06 t/ha), cane yield (132.63 t/ha), CCS% (16.63%), Brix (21.88), Purity (95.40%) and sucrose content (22.52%), respectively as compared to untreated control. However, it was found statistically at par with treatment with foliar spray of Mancozeb 75 WP @ 3 gm/lit in case of growth, yield contributing and quality parameters. Thus, the use of MPKV bioconsortia, particularly at 10 g/l as a foliar spray, offers a sustainable and effective approach for integrated management of Pokkah boeng disease, while simultaneously enhancing crop productivity and quality making it a recommended practice for sugarcane growers with reduce toxic effect of chemicals in animals and soil.

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