

Original Research Article

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## Evaluation of Different Novel Chemicals against Panama Wilt of Banana Incited by *Fusarium oxysporum* f. sp. *cubense* TR4

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### ABSTRACT

Total six novel chemicals viz., Carbendazim (Bavistin), Hexaconazole (Convax plus), Tebuconazole (Folicur), Tebuconazole50%+ Trifloxystrobin 25% (Nativo), Fosetyl-Al (Aliette) and Fluopyram 17.7%+ Tebuconazole17.7% (Luna) were evaluated against *Fusarium oxysporum* f. sp. *cubense* TR4 at 50, 100, and 150 ppm concentration. Data revealed that the 100% inhibition was recorded in Tebuconazole50%+ Trifloxystrobin 25% even at 50 ppm followed by Fluopyram 17.7% + Tebuconazole17.7% and Tebuconazole with 100% inhibition over control at 150 ppm. The Minimum inhibition was found in the Carbendazim with 43.05% inhibition over control at 150 ppm. Same chemicals were tested at 0.2% concentration against Panama wilt of banana under pot condition in poly house. Among the novel chemicals, Tebuconazole 50% + Trifloxystrobin 25% was found most effective against *Fusarium oxysporum* f. sp. *cubense* TR4, in which wilt symptom was not observed up to 78 days after inoculation (DAI) in cv. Grand naine followed by Tebuconazole in which wilt disease was not found before 55 DAI while in Hexaconazole 52 DAI, Fosetyl-Al 50 DAI, Carbendazim 48 DAI whereas in Fluopyram 17.7%+ Tebuconazole17.7% wilt symptoms were appeared in 47 DAI. In control where no treatment was applied wilt symptom was seen in 21 days with a 96% wilt index. Maximum 77.09% inhibition over control was recorded in Tebuconazole 50% + Trifloxystrobin 25% followed by 52.09% in Fluopyram 17.7%+ Tebuconazole17.7%, 50.00% in Tebuconazole, 48.96% in Hexaconazole, 45.83% in Carbendazim and minimum 29.17% in Fosetyl-Al.

#### Keywords

*Fusarium oxysporum* f.sp. *cubense* TR4 (FOC TR4), Novel chemicals, Panama wilt

#### Article Info

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### Introduction

Banana is one of the important commercial fruit crops grown in the tropical and sub-tropical regions not only in India but also in the world. Production and productivity per unit area in India is very low. Low production and productivity may be due to many factors, among them diseases are playing a major role.

Many micro-organisms caused diseases like viruses, bacteria, fungi and nematodes. The most important and economically destructive disease is "Panama wilt", it is also called as *Fusarium* wilt incited by *Fusarium oxysporum* f. sp. *cubense*. The Panama wilt disease is most destructive due to the emergence of new pathogenic race i.e. Tropical race (TR4). Panama wilt disease

incidence in the Dwarf Cavendish group (Grand naine) of bananas was known to occur in state Bihar since 2015. Thangavelu *et al.*, (2019) reported that the existence of tropical race 4 in India. FOC TR4 observed in Katihar and Purnea districts of Bihar in Cavendish group of bananas cultivars Robusta and Grand naine. Damodaran *et al.*, (2019) reported that the FOC TR4 present in Uttar Pradesh in September 2017.

## Materials and Methods

Six fungicides and novel chemicals were evaluated in the laboratory against the pathogen of Panama wilt *Fusarium oxysporum* f. sp. *cubense* TR4 *in vitro*. Their chemical name, trade name, and formulation are given in (Table-1). For the using of poison food techniques 100 ml sterilized potato dextrose (PD broth) medium was mixed with 5mg (0.005ml), 10mg (0.01ml) and 15mg (0.015ml) of fungicides or novel chemicals separately to get @ concentration of 50, 100 and 150ppm. Take 20 ml of each concentration of media was pore in each sterilized Petri plate and allow solidifying in laminar airflow cabinet. After solidification, 5mm disc having seven days old pure culture of test fungus i.e. *Fusarium oxysporum* f. sp. *cubense* TR4 was placed in the centre of Petri-plates in inverse direction and incubated at  $28 \pm 2^{\circ}\text{C}$ . Each treatment was replicated three times with control in which no chemical was added in the medium. The radial growth of pathogen *Fusarium oxysporum* f. sp. *cubense* TR4 was note after 24 hrs of inoculation and ensuing observation was recorded at 48 hrs of interval till complete growth of the fungal pathogen in control i.e. 240 hrs and percent inhibition was determined by the following formula given by Vincent (1927).

$$I = \left( \frac{C - T}{C} \right) \times 100$$

Where,

I = Percent growth inhibition

C = Control Petri plate colony diameter

T = Treated Petri plate colony diameter

The percent inhibition data were statistically analysed by using completely randomized design (C.R.D)

## Results and Discussion

Total six fungicides viz., Carbendazim, Hexaconazole, Tebuconazole, Tebuconazole50% + Trifloxystrobin 25%, Fosetyl-Al and Fluopyram 17.7% + Tebuconazole17.7% were evaluated against *Fusarium oxysporum* f.sp. *cubense* TR4 at 50, 100 and 150 ppm concentration. The radial growth was measured after 24 hrs of inoculation and subsequent observations were recorded at five and ten days intervals till full growth of the pathogen in control i.e. 240 hrs. Complete inhibition of radial growth was observed in Nativo (Tebuconazole 50%+ Trifloxystrobin 25%), Luna (Fluopyram 17.7% + Tebuconazole 17.7) and Folicur (Tebuconazole) at 50, 100 and 150 ppm respectively (Fig. 1 and 2).

Percent inhibition over control was calculated based on the final observation. The result shows that all the fungicides at 50, 100 and 150 ppm concentration significantly inhibited the growth of *Fusarium oxysporum* f.sp. *cubense* TR4 when compared with control. Data revealed that the 100% inhibition was recorded in Nativo (Tebuconazole50%+ Trifloxystrobin 25%) even at 50 ppm followed by Luna (Fluopyram 17.7%+ Tebuconazole17.7%) and Folicur (Tebuconazole) with 100% inhibition over control at 150 ppm. The Minimum inhibition was found in the Carbendazim (Bavistin) with 43.05% inhibition over control at 150 ppm (Table-2).

Different novel chemicals were tested at 0.2% concentration against *Fusarium* wilt of banana under pot condition in the poly house. Mass culture of *Fusarium oxysporum* f.sp. *cabense* TR4 was multiplied on sand corn medium added to steam-sterilized soil (15 psi for 30 minutes) in pots @ 5% (w/w). Soil

mixture with inoculums served as a control pot. Each pot was planted with a one-month-old Grand naine (AAA) tissue culture banana plant. The data was recorded based on the first appearance of symptoms of the disease, percent incidence of wilt index, and percent inhibition over control.

**Table.1** Fungicides and novel chemicals details used against the pathogen *Fusarium oxysporum* f. sp. *cabense*TR4 causal agent of Panama wilt of banana

Trade name	Chemical name	Formulation
<b>Bavistin</b>	Carbendazim	50% WP
<b>Convax plus</b>	Hexaconazole	5% EC
<b>Folicur</b>	Tebuconazole	250 EC
<b>Nativo</b>	Tebuconazole 50% +Trifloxystrobin 25%	75 WG
<b>Aliette</b>	Fosetyl-Al	80% WP
<b>Luna</b>	Fluopyra 17.7% + Tebucanazole 17.7%	400SC

**Table.2** Effectiveness of different novel chemicals against *Fusarium oxysporum* f.sp. *cabense* TR4 causing Panama wilt of banana *in vitro*

Treatments		Cons. (ppm)	Radial growth(mm)* at different hrs			
			24 hrs	120 hrs	240 hrs	Inhibition over control (%)
<b>T<sub>1</sub></b>	Bavistin (Carbendazim 50% WP)	50	3.9	26.4	58.2	34.75
		100	2.7	23.0	54.3	39.12
		150	0.8	20.0	50.8	43.05
<b>T<sub>2</sub></b>	Convax plus (Hexaconazole 5% EC)	50	3.6	27.3	47.6	46.63
		100	2.6	22.6	44.1	50.56
		150	1.2	19.8	41.3	53.69
<b>T<sub>3</sub></b>	Folicur (Tebuconazole 250 EC)	50	0.2	0.7	1.4	98.43
		100	0.0	0.0	0.0	100.0
		150	0.0	0.0	0.0	100.0
<b>T<sub>4</sub></b>	Nativo(Tebuconazole50%+ Trifloxystrobin 25% 75 WG)	50	0.0	0.0	0.0	100.0
		100	0.0	0.0	0.0	100.0
		150	0.0	0.0	0.0	100.0
<b>T<sub>5</sub></b>	Aliette (Fosetyl-Al 80% WP)	50	6.7	25.4	49.4	44.61
		100	5.3	22.6	45.9	48.54
		150	2.0	13.4	41.5	53.47
<b>T<sub>6</sub></b>	Luna (Fluopyram 17.7%+ Tebuconazole17.7% 400 SC)	50	4.2	22.1	36.2	59.41
		100	0.1	0.4	1.1	98.76
		150	0.0	0.0	0.0	100.0
<b>T<sub>7</sub></b>	Control		13.1	36.8	89.2	
<b>CD at 5%</b>			0.14	0.56	2.25	1.38
<b>S.Em. (±)</b>			0.05	0.19	0.78	0.48
<b>C.V. (%)</b>			3.38	2.44	4.58	1.17

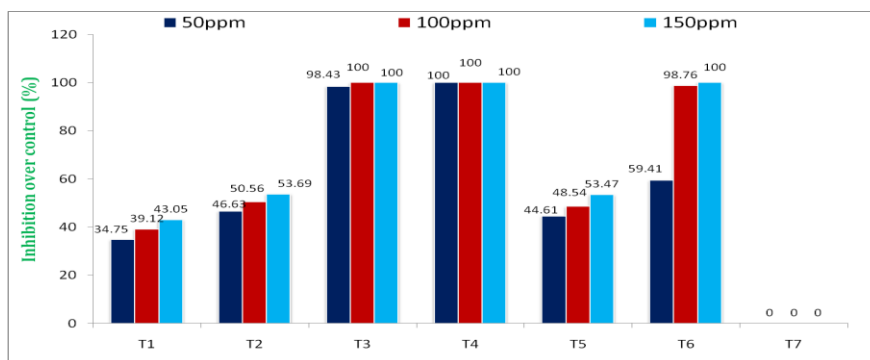
\*Mean of three replications

**Table.3** Effectiveness of different novel chemicals against *Fusarium oxysporum* f. sp. *ubense* TR4 causing Panama wilt of banana under pot condition

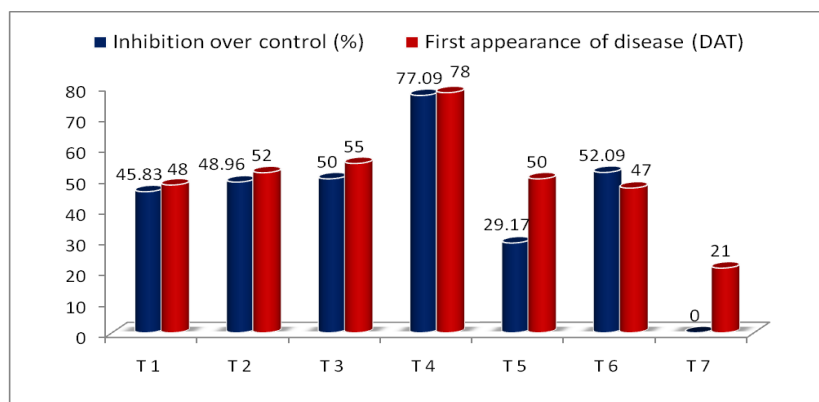
Fungicides		First appearance of disease (DAT)	Incidence (%)	Inhibition over control (%)
T <sub>1</sub>	Bavistin (Carbendazim50% WP)	48	52	45.83
T <sub>2</sub>	Convex plus (Hexaconazole 5% EC)	52	49	48.96
T <sub>3</sub>	Folicure (Tebuconazole 250 EC)	55	48	50.00
T <sub>4</sub>	Nativo(Tebuconazole50%+ Trifloxystrobin 25% 75 WG)	78	22	77.09
T <sub>5</sub>	Aliette (Fosetyl-AI 80% WP)	50	68	29.17
T <sub>6</sub>	Luna(Fluopyram17.7%+ Tebuconazole17.7% 400 SC)	47	46	52.09
T <sub>7</sub>	Control	21	96	
CD at 5%		1.77	1.77	0.98
S.Em. (±)		0.58	0.58	0.31
C.V. (%)		2.00	1.84	1.08

\*Mean of three replications

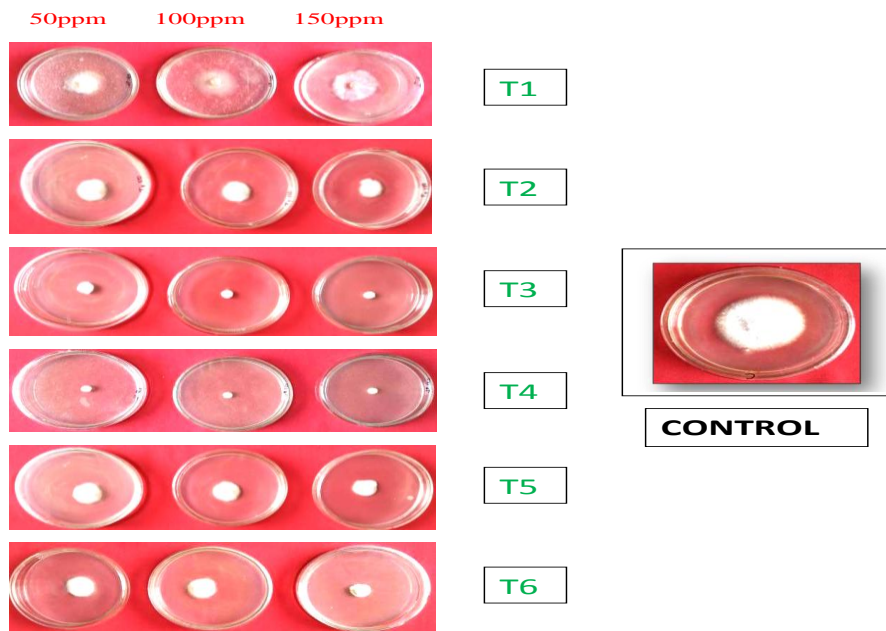
**Fig.1** Effectiveness of different novel chemicals against *Fusarium oxysporum* f.sp. *ubense* TR4 causing Panama wilt of banana *in vitro*



**Fig.2** Effectiveness of different novel chemicals against *Fusarium oxysporum* f.sp. *ubense* TR4 causing Panama wilt of banana under pot condition



**Plate.1** Effectiveness of different novel chemicals against *Fusarium oxysporum* f.sp. *cubense* TR4 causing Panama wilt of banana *in vitro*



**Plate.2** Effectiveness of different novel chemicals against *Fusarium oxysporum* f.sp. *cubense* TR4 causing Panama wilt of banana under pot condition



Among the novel chemicals, Nativo (Tebuconazole 50% + Trifloxystrobin 25%) was found most effective against *Fusarium oxysporum* f.sp. *cubense* TR4, in which wilt symptom was not observed up to 78 days after inoculation (DAI) in cv. Grand naine followed by Folicur (Tebuconazole) in which wilt disease was not found in 55 DAI while in Hexaconazole (Convax plus) 52 DAI, Fosetyl-Al (Aliette) 50 DAI, Carbendazim (Bavistin) 48 DAI whereas in Luna (Fluopyram 17.7% + Tebuconazole 17.7%) wilt symptoms were appeared in 47 DAI.

In control where no treatment was applied wilt symptom was seen in 21 days with a 96% wilt index. Maximum 77.09% inhibition over control was recorded in Nativo (Tebuconazole 50% + Trifloxystrobin 25%) followed by 52.09% in Luna (Fluopyram 17.7%+ Tebuconazole 17.7%), 50.00% in Folicur (Tebuconazole), 48.96% in Hexaconazole (Convax plus) 45.83% in Carbendazim (Bavistin) and minimum 29.17% in Fosetyl-Al (Aliette) (Table-2).

Present findings showed agreement with observations of many earlier workers. Li chi *et al.*, (2008) evaluated nine different fungicides, including 45% Sportak (carbendazim + prochloraz), 50% Sporgon (prochloraz), 50% Ipredine, 50% thiram, 50% carbendazim, 15% Omiral, 2.5% Tilt (propiconazole) etc. and observed that 45% Sportak, 2.5% Tilt and 50% Sporgon had effectiveness, greatly reducing the pathogen; their EC<sub>50</sub>/mg/L values were 0.00094, 0.039 and 0.4895 respectively. Mengal *et al.*, (2016) evaluated five different fungicides against *Fusarium oxysporum*. The result indicate that Nativo was found most effective in prevent the colony growth of fungus (3.3mm) followed by Alliete (8.66mm) and Cabriotop (19.00mm).

Keerio *et al.*, (2017) reported that native was found maximum effective inhibition in linear

colony growth of the fungus at its highest and lowest doses 7.00mm, followed by alliete 16.1 mm, whereas, romeo and cabriotop found less effective as compared to nativo and alliete. Dragon was found least effective as compared to other four fungicides which inhibit at highest dose the linear colony growth was found 64.467 mm against tested fungi. Niwas *et al.*, (2020) conducted experiment with six different fungicides viz. azoxystrobin, carbendazim and propiconazole used against *Fusarium oxysporum* f.sp. *cubense* incited Panama wilt disease of banana. The result revealed that among the fungicides used, carbendazim at 500 and 750 ppm inhibited cent percent mycelial growth of *Fusarium oxysporum* f.sp. *cubense* followed by azoxystrobin 32.96, 11.30, 8.12 and 7.16 mm at 100, 250, 500 and 750 ppm respectively.

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