Plant Archives Vol. 25, Supplement 2, 2025 pp. 1680-1682 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2025.v25.supplement-2.211

IN VITRO EFFICACY OF SYSTEMIC FUNGICIDES AGAINST *STAGONOSPOROPSIS CUCURBITACEARUM*

Kottam Sushma[1]*, K. Gopal[1], Ch. Ruth[1], K. Arunodhayam[1], Syed Sadarunnisa[2] and V.V. Padmaja[3]
[1]Department of Plant Pathology, Dr.Y.S.R.H.U., Andhra Pradesh-516105, India
[2]Department of Horticulture, Dr. Y.S.R.H.U. Andhra Pradesh-516105, India
[3]Department of Plant Physiology, Dr.Y.S.R.H.U. Andhra Pradesh-516105, India
*Corresponding author E-mail: sushmakottam1927@gmail.com
(Date of Receiving : 14-05-2025; Date of Acceptance : 18-07-2025)

ABSTRACT

An *in vitro* study was conducted to evaluate the efficacy of six different fungicides-Carbendazim+ Mancozeb, Azoxystrobin+ Difenoconazole, Hexaconazole, Fluxapyroxad+ Pyraclostrobin,Iprovalicarb+ Propineb and Tebuconazole+ Trifloxystrobin - at three concentrations against *Stagonosporopsis cucurbitacearum*. All fungicides significantly inhibited fungal growth, with inhibition increasing as concentration increased. Azoxystrobin+ Difenoconazole exhibited the highest efficacy, achieving 100% inhibition at 0.3% and 0.4% concentrations. Fluxapyroxad+ Pyraclostrobin followed with 92.22% inhibition at 0.3% concentration. Hexaconazole was the least effective, with inhibition ranging from 63.33% to 72.22%. These findings highlight the potential of Azoxystrobin+ Difenoconazole as an effective fungicide for managing *S. cucurbitacearum*.
***Keywords* :** Systemic Fungicides, *Stagonosporopsis cucurbitacearum.*

Introduction

Gummy stem blight (GSB), caused by *Stagonosporopsis cucurbitacearum* (syn. *Didymella bryoniae*; anamorph: *Phoma cucurbitacearum*), is a destructive fungal disease affecting cucurbitaceous crops worldwide. The disease leads to significant yield losses due to vine defoliation, fruit rot, and plant decay, with reported losses of up to 100% in watermelon (Bala and Hosein, 1986), 43% in the USA (Kienth and Duthie, 1998), and 35% in cucumber (Leski, 1984). In India, it has been reported on multiple cucurbits, including *Cucumis sativus*, *Momordica charantia*, *Benincasa hispida*, and *Cucumis melo* (Kumar and Khan, 1984; Kulwant and Shetty, 1996; Pandey and Pandey, 2003; Sudisha et al., 2004). Chemical fungicides remain the primary method for managing this disease, with systemic fungicides playing a crucial role in disease suppression. However, the extensive and indiscriminate use of fungicides has led to the development of fungicide resistance in the pathogen, reducing their long-term effectiveness. Additionally, environmental concerns associated with chemical treatments necessitate a more strategic approach to disease management. Evaluating the efficacy of systemic fungicides is essential to identify the most effective options for controlling *S. cucurbitacearum* while minimizing resistance risks. This study aims to assess the *in vitro* effectiveness of selected systemic fungicides against *S. cucurbitacearum* to provide insights into their potential role in disease management strategies.

Material and Methods

Poison Food Technique was used to test six different fungicides at different concentrations against GSB pathogen. In this technique, test pathogen was inoculated on the medium containing test chemical. PDA was used as a basal medium. Appropriate quantity of fungicidal suspensions of different concentrations were prepared aseptically in 100 ml of PDA in 250 ml flasks by dissolving requisite quantities of each fungicide in warm sterilized PDA media. Flask containing media without fungicide was used as control. About 20 ml of sterilized media was poured in sterilized petri dish. After solidification of media, the plates were aseptically inoculated with 5 mm mycelial disc, cut from the periphery of 7 days old culture of fungi with the help of sterilized cork borer and then placed at the centre of poisoned PDA. Suitable control was maintained simultaneously by growing the fungus on chemical free PDA. Three replications were used for each concentration of all fungicides. The petri plates were incubated at 25±1°C and the observations on mycelial growth of test fungus were recorded after full growth of the pathogen in the control plate. Per cent inhibition of radial growth of fungus due to different fungi toxicant treatments at different concentrations were computed using the following formula given by (Vincent, 1947).

The percent of inhibition of the pathogen will be calculated using the formula Vincent (1947):

$$\text{Percent inhibition (PI)} = \frac{C - T}{C} \times 100$$

PI = Per cent inhibition
C = Growth of the pathogen in control (mm)
T = Growth of the pathogen in dual culture (mm)

Results and Discussion

Six different fungicides *viz*., Carbendazim+ mancozeb, Azoxystrobin+ difenconazole, Hexaconazole, Fluxapyroxad+ Pyraclostrobin, Iprovalicarb+ Propineb and Tebuconazole+ Trifloxystrobin each at three different concentrations were evaluated against *Stagonosporopsis cucurbitacearum* under *in vitro*. Varied level of per cent inhibition was exhibited by different fungicides used in the experiment on the growth of *Stagonosporopsis cucurbitacearum*. A significant inhibitory effect was shown by all the treatments against the growth of the fungus. The highest mean per cent inhibition of mycelial growth was observed with Azoxystrobin+Difenconazole (100%). The least effective fungicide was hexaconazole, with a mean per cent inhibition of 63.33%. The results revealed that each fungicide with an increase in its concentration increased the per cent inhibition of *Stagonosporopsis cucurbitacearum*.

The evaluation of fungicides at different concentrations revealed that Azoxystrobin + Difenconazole at 0.3% and 0.4% concentrations has shown complete inhibition of 100%. It was followed by Fluxapyroxad + Pyraclostrobin with 92.22% inhibition at 0.3% concentration. The least per cent inhibition of 63.33 to 72.22% was observed in hexaconazole at three different concentrations.

Experiments were conducted by several researchers *viz*., Keinath (2021), Bhat *et al*. (2021) and Savitha and Garampalli (2022) on chemical control of *Stagonosporopsis cucurbitacearum* in cucurbits. The efficacy of fungicides in preventing pathogenic fungi was achieved by promoting the production of phenolic compounds in plants. These phenolic compounds prevented cell wall degrading enzymes of fungi, as reported by Mandavia *et al*. (1999). The present results in the supremacy of azoxystrobin are in agreement with the findings of Utkhede and Koch (2004) and Rahman *et al*. (2019), who reported that azoxystrobin is best at inhibiting the infection caused by *D. bryoniae*. Strobilurins are effective in controlling plant infections caused by all the major groups of fungi. These strobilurins were site-specific molecules that hamper mitochondrial respiration by inhibiting electron transfer in mitochondrial bc_1 complex and difenconazole targets fungal sterol biosynthesis attributing to its superior effectiveness in controlling the pathogen (Yuan *et al*., 2024).

Table 1: *In vitro* evaluation of fungicides against *Stagonosporopsis cucurbitacearum*

S. No	Fungicides	Concentration (%)	Mean diameter of colony (mm)	Per cent inhibition
1	Carbendazim 12% + Mancozeb 63% WP	0.1	24.44	75.56 (60.37)
		0.2	12.00	80.00 (63.44)
		0.3	16.67	83.33 (65.91)
2	Azoxystrobin 20%W/V + Difenconazole 12.5% W/V	0.2	3.33	96.67 (79.48)
		0.3	0	100.00 (90.00)
		0.4	0	100.00 (90.00)
3	Hexaconazole 5%EC	0.05	36.67	63.33 (52.73)
		0.07	31.11	68.89 (56.10)
		0.10	27.78	72.22 (58.20)
4	Fluxapyroxad 25% + Pyraclostrobin 25%SC	0.1	12.22	87.78 (69.54)
		0.2	10.00	90.00 (71.57)
		0.3	7.78	92.22 (73.81)

5	Iprovalicarb 5.5% + Propineb 61.25% WP	0.10	18.89	81.11 (64.24)
		0.15	14.44	85.56 (67.66)
		0.20	11.11	88.89 (70.53)
6	Tebuconazole 50%+ Trifloxystrobin 25% WG	0.04	21.11	78.89 (62.65)
		0.05	17.80	82.22 (65.06)
		0.075	14.44	85.56 (67.66)
7.	Control	0	0	0 (0.00)
		C.D.	0.068	0.761
		SE(d)	0.034	0.376
		SE(m) ±	0.024	0.266

Figures in parentheses are arc sine transformed values

Conclusion

The study demonstrated that all tested fungicides significantly inhibited the growth of *Stagonosporopsis cucurbitacearum*, with Azoxystrobin+ Difenoconazole being the most effective, achieving 100% inhibition at higher concentrations. Fluxapyroxad+ Pyraclostrobin also exhibited strong efficacy, while Hexaconazole was the least effective. The superior performance of Azoxystrobin+ Difenoconazole aligns with previous research highlighting the effectiveness of strobilurins and triazoles in fungal control. These findings support the potential of site-specific fungicides in managing *S. cucurbitacearum* infections in cucurbits.

Acknowledgements

My heartfelt thanks to the advisory committee for their constant support and guidance during the course of this research. I am also thankful to the department of Plant Pathology, College of Horticulture, Anantharajupeta, Dr. Y.S.R.H.U., for providing necessary resources and facilities for the completion of this project.

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