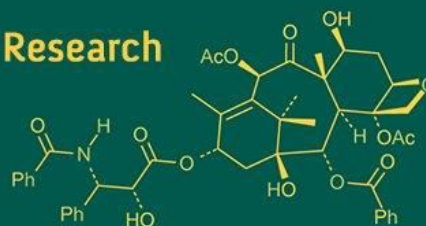


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Bachate AS

M.Sc. Agri., Department of Plant Pathology, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri, Maharashtra, India

Arekar JS

Subject Matter Specialist, Krishi Vigyan KENDRA, Killa-Roha, Raigad Maharashtra, India

Potphode PD

Assistant Professor, Department of Plant Pathology, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri, Maharashtra, India

Raut RA

Assistant Professor, Department of Plant Pathology, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri, Maharashtra, India

Thotat SB

Assistant Professor, College of Horticulture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri, Maharashtra, India

Babhare SV

Ph.D. Agri Department of Plant Pathology, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri, Maharashtra, India

Adsul PR

Ph.D. Agri Department of Plant Pathology, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri, Maharashtra, India

Joshi MS

Head Of Department, Department of Plant Pathology, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri, Maharashtra, India

Corresponding Author:**Bachate AS**

M.Sc. Agri., Department of Plant Pathology, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri, Maharashtra, India

In vitro evaluation of different fungicides and bio agents against jackfruit leaf spot caused by *Colletotrichum gloeosporioides*

Bachate AS, Arekar JS, Potphode PD, Raut RA, Thorat SB, Bhabare SV, Adsul PR and Joshi MS

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Abstract

The leaf spot disease caused by *Colletotrichum gloeosporioides* is most common and serious disease of jackfruit, which significantly decreased the market value of fruits. In present research work, Six fungicides Carbendazim 12% + Mancozeb 63% WP, Carbendazim 50% WP, Copper oxychloride 50% WP, Thiophanate methyl 70% WP, Hexaconazole 5% SC, Tebuconazole 50% + Trifloxystrobin 25% WG concentrations at 0.2%, 0.1%, 0.25%, 0.1%, 0.05% and 0.05% respectively and seven bio agents viz., *Trichoderma viride*, *Trichoderma harzianum*, *Trichoderma longibrachiatum*, *Trichoderma koningii*, *Pseudomonas fluorescens*, *Bacillus subtilis* and *Aspergillus niger* were evaluated *in vitro* against *Colletotrichum gloeosporioides* causing leaf spot of jackfruit, using "Poisoned Food Technique" for fungicide evaluation and "Dual culture technique" for bio agents evaluation with three replications in Completely Randomized Design. Among the fungicides evaluated Carbendazim 12% + Mancozeb 63% WP @ 0.2% and Carbendazim 50% WP @ 0.1% showed 100 percent inhibition of mycelial growth of *Colletotrichum gloeosporioides*. While Copper oxychloride 50% WP @ 0.25% was least effective which showed 61.65% inhibition. Among the used Bioagents, *Trichoderma longibrachiatum* was most effective in inhibiting the mycelial growth of test fungus with 77.98% (19.81 mm). *Bacillus subtilis* was least effective in controlling the mycelial growth of *Colletotrichum gloeosporioides* (40.16%).

Keywords: Jackfruit, *Colletotrichum gloeosporioides*, fungicides, bio agents

Introduction

The jackfruit, a tropical fruit consumed for centuries, is scientifically known as *Artocarpus heterophyllus*. This evergreen tree species, belonging to the Moraceae family, grows 8-25m tall with a straight trunk diameter of 30-80cm. (Ranasinghe *et al.*, 2019) ^[1] Locally, it's referred to as 'jackfruit tree' in English, while regional names include Kathal (Bangladesh), Jaqueira (Brazil), Jackfruchtbaum (Germany), and Nangka or Nongko (Indonesia). In India, it's known by various vernacular names, such as halasu (Kannada), kathal (Hindi), phanas (Marathi), and pila or pilavu or chakka (Tamil and Malayalam) (Cabi 2019) ^[3]. Jackfruit is native to the Western Ghats of India, Asia, Africa, and parts of South America, and jackfruit is a climacteric fruit, widely cultivated in tropical regions. As a non-seasonal fruit crop, jackfruit is a vital resource for both humans and livestock, earning it the designation "poor man's food" (Afroz M and Rahman MA 2016) ^[1].

Jackfruit is a nutrient-rich fruit that offers numerous health benefits. Its high dietary fiber content promotes smooth bowel movements, preventing constipation (Ranasinghe RASN *et al.*, 2019) ^[1]. Jackfruit is rich in minerals, vitamins, enzymes, and antioxidants. It has many nutritional benefits and therapeutic applications. The majority of Jackfruit-growing regions worldwide are affected with leaf spot disease. Among the different plant-pathogenic fungi, *Colletotrichum* is the most prevalent and significant genera. The infection significantly decreased the market value of fruits and posed a major obstacle to the successful production of jackfruit in Konkan region of Maharashtra as well as other regions of the nation. This infection causes dead twigs on jackfruit as well as necrotic lesions on leaves and fruits.

Materials and Methods

The present research work was carried out at the Department of Plant Pathology, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri (M.S.). Efficacy of six fungicides viz., Carbendazim 12% + Mancozeb 63% WP, Carbendazim 50% WP, Copper oxychloride 50% WP, Thiophanate methyl 70% WP, Hexaconazole 5% SC, Tebuconazole 50% + Trifloxystrobin 25% WG at different concentrations were tested *in vitro* against test pathogens separately by applying Poisoned Food Technique (Nene and Thapliyal, 1993) [7]. Three replications were maintained for each treatment. Seven bio agent viz., *Trichoderma viride*, *Trichoderma harzianum*, *Trichoderma longibrachiatum*, *Trichoderma koningii*, *Pseudomonas fluorescens*, *Bacillus subtilis* and *Aspergillus niger* were evaluated *in vitro*, using "Dual culture technique" with three replications in Completely Randomized Design. The inoculated plates were incubated at room temperature (27±2 °C) for seven days and radial colony growth was measured. The efficacy of fungicides and organics was expressed as percent inhibition of mycelial growth over control. percent inhibition was calculated by using the formula given by Vincent, 1947 [14].

$$\text{Percent Inhibition (I)} = \frac{C-T}{C} \times 100$$

Where,

C = Growth (mm) of the test fungus in untreated control plate and

T = Growth (mm) of the test fungus in treated plates.

Results and Discussion

In vitro efficacy of fungicides against *Colletotrichum gloeosporioides*

Data from (Table 1, Plate 1 and Fig. 1) depicted that all the fungicide evaluated at different concentrations were found effective in inhibiting the mycelial growth of *Colletotrichum gloeosporioides*. Carbendazim 12% + Mancozeb 63% WP @ 0.2%, Carbendazim 50% WP @ 0.1% were the most significantly effective fungicides in inhibiting the mycelial growth of *Colletotrichum gloeosporioides* with cent percent inhibition over control and 0.00 mm colony diameter. It was followed by Hexaconazole @ 0.05% (83.70%), Tebuconazole 50% + Trifloxystrobin 25% WG @ 0.05% (83.66%), Thiophanate methyl 70% WP @ 0.1% (82.75%) and Copper oxychloride @ 0.25% (61.65%) inhibition.

The results of present investigation are in accordance with the results obtained by according to the conclusions of Jayalakshmi *et al.* (2015) [3], Carbendazim 12% + Mancozeb 63% caused cent percent disease control of *C. gloeosporioides* at different concentration. This result shows that the combi product Carbendazim 12% + Mancozeb 63% inhibited percent mycelial growth of *C. gloeosporioides* at different concentration. Ramani *et al.* (2015) [10] who found that complete mycelial growth inhibition of the *C. gloeosporioides* causing anthracnose of banana was observed due to Carbendazim 12% WP + Mancozeb 63% WP were most effective and gave 100% growth inhibition at all concentration viz., 100ppm, 250ppm, 500ppm and 1000ppm respectively. Dev and Narendrappa (2016) [2] observed that Trifloxystrobin 25% + Tebuconazole 50%

WG showed cent percent inhibition at 100, 250, 500, 1000ppm concentrations against *C. gloeosporioides* causing anthracnose of pomegranate. Behera *et al.* (2019) [12] examined the efficacy of against *Colletotrichum gloeosporioides* causing anthracnose in black pepper. He found that maximum growth inhibition of fungus was observed in case of Carbendazim 12% + Mancozeb 63% WP (0.1%) 97.26% which is followed by Carbendazim 50% WP (0.2%) 91.24%. The results are also in close proximity with the results obtained by Sharma *et al.* (2019) [12], Kadlag *et al.* (2023) [6] and Vanani *et al.* (2024) [13].

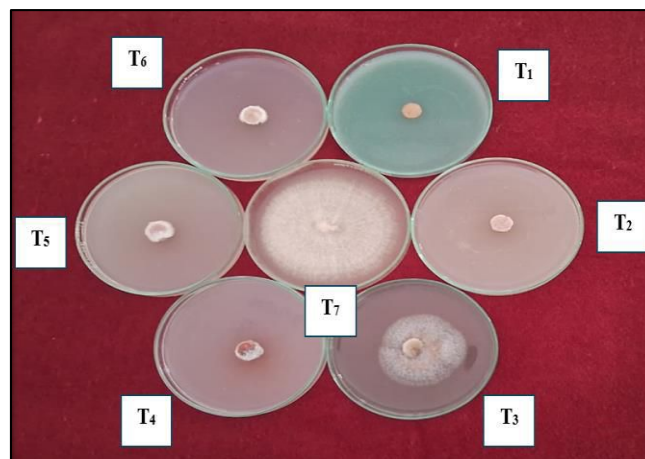


Plate 1: *in vitro* efficacy of fungicides against *Colletotrichum gloeosporioides*

Table 1: *in vitro* efficacy of fungicides against *Colletotrichum gloeosporioides*

Tr. No.	Treatments	Conc. (%)	Colony dia. (mm)*	Percent Inhibition
T1	Carbendazim 12% + Mancozeb 63% WP	0.2	0.00	100.00
T2	Carbendazim 50% WP	0.1	0.00	100.00
T3	Copper oxychloride 50% WP	0.25	34.51	61.65
T4	Thiophanate methyl 70% WP	0.1	15.52	82.75
T5	Hexaconazole 5% SC	0.05	14.67	83.70
T6	Tebuconazole 50% + Trifloxystrobin 25% WG	0.05	14.70	83.66
T7	Control	-	90.00	-
	S.E.m±	-	0.47	-
	C.D. at 1%	-	1.97	-

(*Mean of three replications)

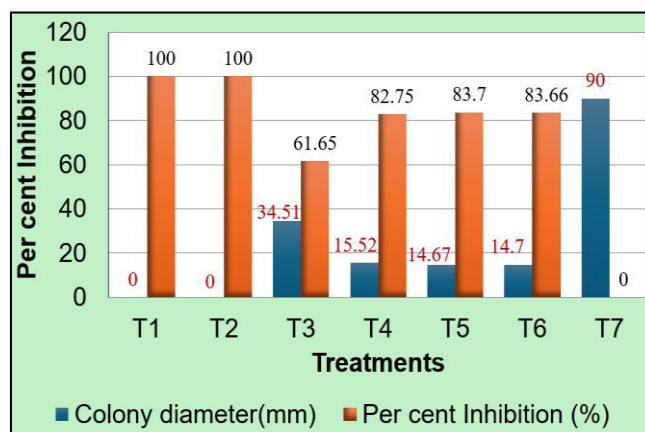


Fig 1: Colony diameter (mm) and percent inhibition (%) of different fungicides against *Colletotrichum gloeosporioides*

In vitro* efficacy of Bioagents against *Colletotrichum gloeosporioides

Data from table 2, plate 2 and fig. 2 revealed that all the Bioagents evaluated were effective in inhibiting the mycelial growth of leaf spot causing fungus *Colletotrichum gloeosporioides*. *Trichoderma longibrachiatum* was most significantly effective in inhibiting the mycelial growth of test fungus with 77.98% (19.81 mm). Followed by, *Aspergillus niger* (69.42%) (27.52 mm), *T. koningii* (66.25%) (30.37 mm), *T. harzianum* (63.30%) (33.03 mm), *Trichoderma viride* (61.61%) (34.55 mm), and *Bacillus subtilis* (40.16%) (53.85 mm) and *Pseudomonas fluorescens* was least effective in controlling the mycelial growth of *Colletotrichum gloeosporioides* with 37.57 percent inhibition and 56.18 mm colony diameter.

The results obtained in the present studies are in close consonance with the results reported by Patel and Joshi (2001) [8] investigated the antagonistic ability of *T. viride*, *T. harzianum*, *T. longibrachiatum*, *Gliocladium virens*, *Aspergillus niger*, *Pseudomonas fluorescens* and *Bacillus subtilis* against *C. gloeosporioides* causing leaf spot of turmeric. *T. viride* caused maximum inhibition (66.40%), whereas in test organism at centre technique, *T. harzianum* inhibited max. growth (65.75%) and in pathogen at centre technique, *T. longibrachiatum* inhibited max. growth (65.61%) of the pathogen. However Pavithra and Benagi (2016) [9] reported, among bioagents *Bacillus subtilis*, *Pseudomonas fluorescens*, *Trichoderma viride* and *T. harzianum* were tested against *C. gloeosporioides*. Among the all bioagents tried, *Trichoderma viride* was found to be

best in inhibiting the mycelial growth of *C. gloeosporioides* (80.22%) followed by *Trichoderma harzianum* (77.11%) and *Pseudomonas fluorescens* (70.89%) and least percent inhibition of mycelial growth was observed in *Bacillus subtilis* (64.00%).

Hence, it is proved that different species of *Trichoderma* having antagonistic activity to inhibited percent mycelial growth of the pathogen by expressing different mechanism like parasitism, competition for food, releasing of toxic substance and hyper parasitism.



Plate 2: *In vitro* efficacy of Bioagents against *Colletotrichum gloeosporioides*

Table 2: *In vitro* efficacy bioagents against *Colletotrichum gloeosporioides*

Tr. No.	Treatment	Mean Colony diameter (mm)	Percent inhibition
T ₁	<i>Trichoderma viride</i>	34.55	61.61
T ₂	<i>Trichoderma harzianum</i>	33.03	63.30
T ₃	<i>Trichoderma longibrachiatum</i>	19.81	77.98
T ₄	<i>Trichoderma koningii</i>	30.37	66.25
T ₅	<i>Pseudomonas fluorescens</i>	56.18	37.57
T ₆	<i>Bacillus subtilis</i>	53.85	40.16
T ₇	<i>Aspergillus niger</i>	27.52	69.42
T ₈	Control	90.00	-
	S. Em±	1.34	-
	C.D at 1%	5.52	-

(*Mean of three replications)

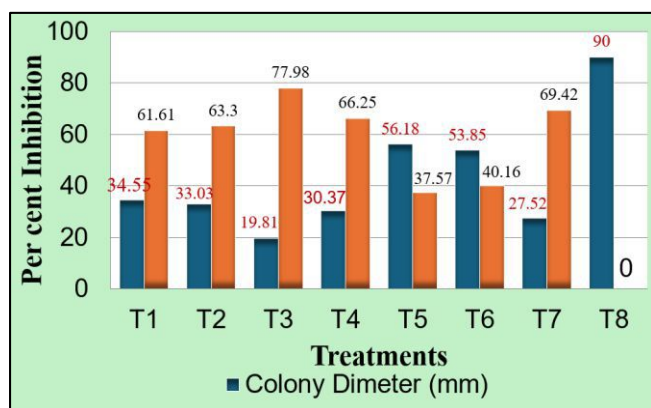


Fig 2: Colony diameter (mm) and percent inhibition (%) of different Bioagents against *Colletotrichum gloeosporioides*

Conclusion

The results of present experiment, concluded that among the *in vitro* evaluated fungicides, Carbendazim 12% +

Mancozeb 63% WP @ 0.2% and Carbendazim 50% WP 0.1% inhibited cent percent mycelial growth while the different bio agents evaluated, *Trichoderma longibrachiatum* are most effective in inhibiting mycelial growth of *Colletotrichum gloeosporioides* causing leaf spot of jackfruit.

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