International Journal of Statistics and Applied Mathematics

ISSN: 2456-1452
Maths 2023; SP-8(6): 1467-1469

https://www.mathsjournal.com
Received: 19-09-2023
Accepted: 25-10-2023

Sominath A Falke
Research Assistant, Department of Plant Pathology, VNMKV Parbhani, Maharashtra, India

Dr. Pavan K Dhoke
Cotton Pathologist, Cotton Research Station, Nanded, Maharashtra, India

Shridhar N Banne
Ph.D. Research Scholar, Department of Plant Pathology, VNMKV Parbhani, Maharashtra, India

Corresponding Author:
Sominath A Falke
Research Assistant, Department of Plant Pathology, VNMKV Parbhani, Maharashtra, India

Analytical study on *in vitro* bioefficacy of bioagents against *Colletotrichum capsici* (Syd.) Butler and Bisby, causing Anthracnose of Chilli using CRD design

Sominath A Falke, Dr. Pavan K Dhoke and Shridhar N Banne

DOI: https://doi.org/10.22271/maths.2023.v8.i6Ss.1750

Abstract
Chilli [*Capsicum annuum* L.] is a significant spice/ vegetable crop grown in India and prone to many diseases. Among different diseases of chilli, Anthracnose caused by *Colletotrichum capsici* (Syd.) Butler and Bisby is one of the most important disease and causes drastic losses in crop yield. *C. capsici (Syd.)* Butler and Bisby is air borne, seed borne also water borne pathogen and difficult to manage by use of fungicides alone. Therefore, *in vitro* study was attempted to evaluate the *in vitro* efficacy of seven potent bioagents *viz*., *Trichoderma asperellum*, *T. harzianum*, *T. virens*, *Paecilomyces lilacinus*, *Metarhizhium anisopliae*, *Verticillium lecanii* and *Aspergillus niger* against *C. capsici* (Syd.) Butler and Bisby, at the Department of Plant Pathology, VNMKV, Parbhani. All bioagents were found antagonistic to the fungus, but most efficient was, *T. asperellum*, resulted with significant maximum mycelial growth inhibition (52.51%), of the test pathogen. The second and third inhibitoriest antagonists found were *T. harzianum* and *T. virens* with the inhibition of 48.97% and 43.13%, respectively.

Keywords: Chilli, *Colletotrichum capsici*, anthracnose, inhibition, bioagents

Introduction
Chilli (*Capsicum annuum* L.), belongs to the family Solanaceae is an important spice cum vegetable crop of the world. Chilli is native of tropical America (Brazil) and has been propagated throughout the world including the tropics, subtropics, and temperate regions. (Pickersgill, 1997) [9]. Chillies are the good sources of vitamin ‘A’, vitamin 'B' and vitamin 'C' and minerals like calcium, phosphorus, ferrous, sodium and copper in trace amounts. Chillies produce alkaloids, capsaicinoids, carotenoids and red pigments (Capsanthin, Capsorubin and Capxanthin) which make chilli hot and pungent (Kumar *et al*., 2019) [6].

India is the world’s largest producer, consumer and exporter of chilli and contributes about 25 per cent to total world production. Pungent varieties of chilli contribute about 30 per cent of the total production which attract international trade. According to the 2007-08 data, chilli in India occupies an area of 805.8 thousand 2 hectares, with production of 1297.9 thousand tonnes and yield of 1611 kg/hectare, respectively. (Anonymous, 2020) [1].

Chilli crop is attacked with different pests and pathogens in field and during post-harvest, contamination with mycotoxins are major constraints in chilli production. Worldwide, *Capsicum* is vulnerable to various pests, weeds, fungal, bacterial, and viral pathogens; among the fungal diseases, anthracnose/die-back/fruit-rot of chillies is an important disease-causing serious loss in field, transit, transport, and storage (Kiran *et al*., 2020) [5]. Among a number of fungal, bacterial and viral diseases, Anthracnose/fruit rot caused by *Colletotrichum capsici* (Syd.) Butler and Bisby is an economically important disease of chilli, causing yield losses more than 50 per cent and is one of the most destructive disease and commonly prevailing in almost all chilli growing major areas of India. Whatever, chilli varieties under cultivation are more or less prone to anthracnose.

Hence, employing biocontrol agents to manage the diseases seems to be eco-friendly, cost-effective and promising option, over chemical disease management. Therefore, present study was undertaken to evaluate *in vitro* efficacy of efficient biocontrol agents against *Colletotrichum capsici* (Syd.) Butler and Bisby, causing Anthracnose disease of chilli.

Materials and Methods

A total seven fungal antagonists *viz*., *Trichoderma asperellum*, *T. harzianum*, *T. virens*, *Paecilomyces lilacinus*, *Metarhizhium anisopliae*, *Verticillium lecanii* and *Aspergillus niger* were evaluated *in vitro* against *C. capsici* (Syd.) Butler and Bisby, applying dual culture technique (Dennis and Webster, 1971) [4]. Seven days old pure cultures of the test pathogen and test bioagents grown on PDA medium were used for the study. Two 5 mm culture discs, one each of the test pathogen and the test bio-agent were cut out with sterilized cork borer and inoculated at equidistance and exactly opposite to each other on autoclaved and solidified PDA medium in Petri plates and plates were incubated at 27±1 °C. PDA plates inoculated alone with pure culture disc (5 mm) of the test pathogen were maintained as control. The experimental details were as given below.

Experimental details

Design: CRD

Replications

Three

Treatments: Eight

Trématent détails

Tr. No.	Treatments
T_1	*Trichoderma asperellum*
T_2	*Trichoderma harzianum*
T_3	*Trichoderma virens*
T_4	*Paecilomyces lilacinus*
T_5	*Metarhizhium anisopliae*
T_6	*Verticillium lecanii*
T_7	*Aspergillus niger*
T_8	Control (Untreated)

Observations on linear mycelial growth of the test fungus and bioagent were recorded at an interval of 24 hours and continued till untreated control plates were fully covered with mycelial growth of the test fungus. Per cent inhibition of the test fungus by the bioagents over untreated control were calculated by applying following formula (Arora and Upaddhyay, 1978) [2].

$$\text{Per cent Growth Inhibition (PGI)} = \frac{\text{Colony growth in Control plate} - \text{Colony growth in intersecting plate}}{\text{Colony growth in control plate}} \times 100$$

Results and Discussion

The results presented in (Table 1, Plate 1 and Figure 1) demonstrate the *in vitro* effectiveness of various bioagents in reducing the mycelial growth of *C. capsici* (Syd.) Butler and Bisby, a fungal disease that affected crops. The eight treatments and associated pathogen colony diameters, as well as per cent inhibition had been presented. In addition, standard error (SE) and critical difference (CD) values at a 1% significance level are shown to assess statistical significance.

Table 1: *In vitro* efficacy of different bioagents on mycelial growth and inhibition against *C. capsici*

Tr. No.	Treatments	Radial mycelial growth (mm)*	% Inhibition
T_1	*Trichoderma asperellum*	42.73	52.51
T_2	*T. harzianum*	45.91	48.97
T_3	*T. virens*	51.18	43.13
T_4	*Paecilomyces lilacinus*	63.89	29.00
T_5	*Metarhizium anisopliae*	63.54	29.39
T_6	*Verticillium lecani*	68.10	23.55
T_7	*Aspergillis niger*	56.19	37.55
T_8	Control	90	00.00
	SE±	0.48	0.67
	CD at 1%	1.48	2.05

Radial mycelial growth

The results (Table- 1, Plate- 1, Figure- 1) revealed that, the out of seven biocontrol agents tested, *T. asperellum* (T1) (42.73 mm) was found most effective in controlling the effective the mycelial growth of *C. capsici* which was statistically significant with rest of the treatments and untreated control. The *T. harzianum* (T2) was found next effective biocontrol agent and recorded (45.91 mm) mycelial growth of *C. capsici*, followed by *T. virens* (T3) (51.18 mm). Both the treatments were statistically significant with each other and rest of the treatments including untreated control. The maximum growth was recorded by *V. leccani* T6 (68.10 mm) which was followed by *P. lilacinus* T4 (63.89 mm), *M. anisopliae* T5 (63.54 mm) and *A. niger* T7 (56.19 mm). The treatment *M. anisopliae* (T5) (63.54 mm) was at par with the treatments of *P. lilacinus* (T4) (63.89 mm).

Inhibition of mycelial growth

The per cent mycelial inhibition results (Table- 1, Plate-1, Figure- 1) of *C. capsici* in different treatments of biocontrol agents revealed that, the out of seven biocontrol agents tested, *T. asperellum* (T1) (52.51%) was found most effective in the per cent inhibition of mycelial growth of *C. capsici* which was statistically significant with rest of the treatments and untreated control. The *T. harzianum* (T2) was found next effective biocontrol agent and recorded (48.97%) the per cent inhibition of mycelial growth of *C. capsici*, followed by *T. virens* (T3) (43.13%). Both the treatments were statistically significant with each other and rest of the treatments including untreated control. The least per cent inhibition of mycelial growth was recorded by *V. leccani* (T6) (23.55%) which was followed by *P. lilacinus* (T4) (29.00%), *M. anisopliae* (T5) (29.39%) and *A. niger* (T7) (37.55%). The

treatment *M. anisopliae* (T5) (29.39%) was at par with the treatments of *P. lilacinus* (T4) (29.00%).

Thus, the bioagents *viz*., *T. asperellum*, *T. harzianum*, and *T. virens* were found most potential antagonists against *Colletotrichum capsici* (Syd.) Butler and Bisby.

These results of the present study are in consonance with the reports of several earlier workers. Laxman (2006) [7] reported that among fungal bioagents tested, *T. harzianum* was found to be most effective in suppressing growth of *C. truncatum*. Padder *et al*. (2007) [8] reported that *T. viride* caused significant inhibition of mycelial growth (69.21%), followed by *T. harzianum* (64.20%). Birari *et al*. (2018) [3] evaluated some bioagents against *C. capsici* and reported that maximum inhibition of mycelial growth was noticed in *T. viride* (80.48%) and was found to be significantly superior over other treatments. Rao *et al*. (2020) [10] reported that, *T. viride* showed highest inhibition of spore germination (53.51%).

Plate 1: *In vitro* efficacy of bioagents on radial mycelial growth and per cent inhibition of *Colletotrichum capsici*

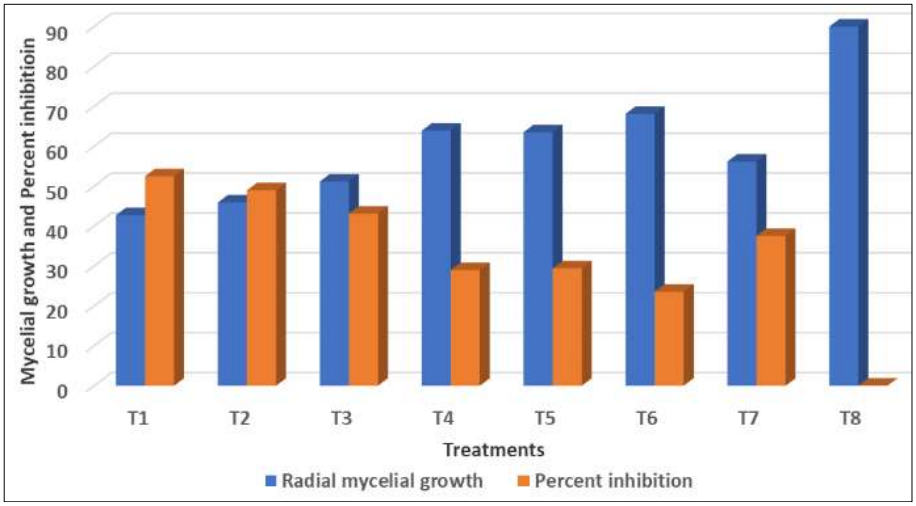

Fig 1: *In vitro* efficacy of bioagents on radial mycelial growth and per cent inhibition of *Colletotrichum capsici*

Conclusions

Bio-control agents such as *T. asperellum*, *T. harzianum*, and *T. virens* proved to be potential antagonist could be extensively employed to manage several plant diseases/pathogens, including *Colletotrichum capsici* (Syd.) Butler and Bisby.

Acknowledgement

We are thankful to the Head of the Department of Plant Pathology, College of Agriculture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani for providing the research facilities.

References

1. Anonymous; c2020. https://www.indiastatagri.com/
2. Arora DK, Upadhyay RK. Effect of fungal staling growth substances on colony interaction. Plant and Soil. 1978;49:685-690.
3. Birari BP, Gade RM, Chuodhari RK. Antifungal efficacy of plant extracts, biocontrol agents against *Colletotrichum capsici* causing anthracnose of chilli. J Pharmacogn Phytochem. 2018;7(5):1368-1373.
4. Dennis KL, Webster J. Antagonistic properties of species group of *Trichoderma* and hyphal interaction. Trans Br Mycol. Soc. 1971;57:363-396.
5. Kiran R, Akhtar J, Kumar P, Shekhar M. Anthracnose of chilli; Status, Diagnosis and Management. 2020;9(4):242-257.
6. Kumar Sanjeev K, Balabaskar P, Kumar S, Siva Kumar T, Muthukumar A. Studies on the cultural and pathogenic variability among isolates of *Colletotrichum capsici* (Syd.) Butler and Bisby causing Anthracnose fruit rot incidence of chilli. Plant Arch. 2019;19(2):3295-3299.
7. Laxman R. Studies on leaf spot of greengram caused by *Colletotrichum truncatum* (Schw.) Andrus and Moore. M. Sc. (Agri.) Thesis, University of Agricultural Science, Dharwad, Karnataka, India; c2006.
8. Padder BA, Sharma PN, Kapoor V, Sharma OM. Genetic Diversity and gene flow estimates among five populations of *Colletotrichum lindemuthianum* across Himachal Pradesh North-Western state of India. Physiol. Mol. Plant Pathol. 2007;70:8-12.
9. Pickersgill B. Genetic resourses and breeding of *Capsicum* spp. Euphytica. 1997;96(1):129-133.
10. Rao SN, Bhattiprolu SL, Gopal AV, Sekhar V. Effect of fungicides, plant extracts and bioagents on spore germination of *Colletotrichum lindemuthianum* causing field bean anthracnose. Bioscan. 2020;15(3):339-344.