International Journal of Environment and Climate Change

Volume 14, Issue 1, Page 479-482, 2024; Article no.IJECC.111580
ISSN: 2581-8627
(Past name: British Journal of Environment & Climate Change, Past ISSN: 2231–4784)

In vitro Evaluation of Antagonistic Effect of Bio Control Agents (BCA) against Mango Dieback Incited by *Lasiodiplodia theobromae* (Pat.) Griffon & Maubl

K. A. Parmar [a++*], K. B. Rakholiya [a#], P. R. Patel [a++] and Neha Singh [b++]

[a] Department of Plant Pathology, NMCA, NAU, India.
[b] IARI, New Delhi, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJECC/2024/v14i13858

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/111580

Original Research Article

Received: 05/11/2023
Accepted: 11/01/2024
Published: 17/01/2024

ABSTRACT

Mango (*Mangifera indica* L.*)* is one of the most important tropical fruit crops, belongs to family anacardiaceae. Mango is infected by number of diseases at all stages of its development, among them dieback caused by *Lasiodiplodia theobromae* (Pat.) Griffon & Maubl. is considered to be the most destructive disease, leading to significant yield loss and low fruit quality of mango due to slowly wilting of tree. The present investigation was carried out to evaluate the inhibitory activity of different bio-control agents (BCA) against *L. theobromae*. Different bioagents *viz., Trichoderma*

[++] *Ph.D. Scholar;*
[#] *Professor and Head;*
**Corresponding author: E-mail: parmarkrishna2501@gmail.com;*

viride NAU isolate, *T. harzianum*, NAU isolate, *Pseudomonas fluorescens* NAU isolate*, Bacillus subtilis* NAU isolate and Rhizospheric actinobacteria were tested by dual culture technique. Among them, highest per cent growth inhibition was found in *T. viride* (71.47%) followed by *T. harzianum* (67.15%) and rhizospheric actinobacteria (47.84%). *P. fluorescens* (3.46%) was found least effective against pathogen. The results indicated that among all the BCA, *T. viride* was most effective against *L. theobromae.* Hence, it can be explored further for management of mango dieback.

Keywords: Mango; die back; bio-control agent; lasiodiplodia; trichoderma.

1. INTRODUCTION

Mango (*Mangifera indica* L.), is a highly significant tropical fruit that is a member of the anacardiaceae family. The mango has earned the title of the "King of fruit" due to its delectable exotic taste, delightful aroma, and its abundance of valuable nutritional compounds [1]. A single medium-sized mango, around 200 grams in weight, supplies an adult with more than their daily vitamin 'A' requirement and three-fourths of the needed vitamin 'C'. This recognition establishes it as one of the top-quality fruits.

While it is cultivated in at least 87 countries, nowhere is the value of mango as pronounced as in India, where it accounts for 40% of the total fruit production in the country. Mango farming is leading fruit crop farming in India where area and production is about 2.325 million ha and 20.822 million tons, respectively [2]. Basically, mango is a tropical crop but it grows in wide range of soils, climate and altitude and is relatively easy to cultivate. Due to wide ranged adaptability of climatic conditions, mango is affected by a number of diseases at all stages of its development, right from the seedling in the nursery to the fruits in storage or transit such as dieback, anthracnose, malformation, powdery mildew etc. Among them, mango dieback is known to be caused by *Lasiodiplodia theobromae* (Pat.) Griffon & Maubl. It is also called as tree decline disease. *L. theobromae* is an aggressive and vigorous pathogen and is able to infect exceptionally large number of host plants, causing various types of disease symptoms *viz*. black root rot, fruit rot, dry rot, wood stain, dieback, stem end rot, seedling rot, graft union blight, twig blight and tip dieback, brown rot of panicle [3,4]. The organism is a wound parasite and capable of causing great damage under favourable conditions. Dieback is considered to be the most destructive disease, leading to significant yield loss and low fruit quality of mango [5]. By considering the severity of the disease, this experiment has been carried out to find out effective and environment friendly management strategy.

2. MATERIALS AND METHODOLOGY

Antagonistic effect of different bioagents *viz*. *Trichoderma viride, T. harzianum*, *Pseudomonas fluorescens, Bacillus subtilis* and rhizospheric actinobacteria was tested by dual culture technique for their antagonism against pathogen [6]. The rhizospheric actinobacteria were isolated using serial dilution technique [7]. for which soil samples were collected from mango rhizosphere. The remaining bio-control agents were collected from laboratory of Department of Plant Pathology, N. M. College of Agriculture, Navsari Agricultural University, Navsari.

Seven days old culture of the bio agents and the pathogen were employed by following dual culture method. Mycelial disc of 5 mm diameter cut from the periphery of both antagonist and test pathogen were placed at 50 mm apart from each other in Petri plates. In case of bacterial bio agents, mixed media of NA (Nutrient Agar) and PDA (Potato Dextrose Agar) were used in the ratio 50:50. Half portion of plates streaked with bacterial bio agent and 5 mm diameter mycelial disc of pathogenic fungi placed on the other side of Petri plates. In control, only test pathogen was kept in the centre of Petri plate. The Petri plates were incubated at 27 ± 1^{0}C in BOD incubator. The observations on mycelial growth (mm) and per cent growth inhibition of test fungi were recorded after 7 days of incubation [8].

$$\mathbf{I = C\text{-}T/C \times 100}$$

Where,
I= Inhibition per cent
C= Colony diameter (mm) in control plate
T= Colony diameter (mm) in treated plate

3. RESULTS AND DISCUSSION

The result of present investigation revealed that, all the antagonists significantly inhibiting the

mycelial growth of *L. theobromae.* The lowest mycelial growth (24.80 mm) was recorded in *T. viride* with highest per cent growth inhibition (71.47 %) as compared to other treatments at seven days after inoculation which is followed by *T. harzianum* (28.50 mm) with 67.15 per cent growth inhibition (PGI). The next best bio control agent in order of merit was rhizospheric actinobacteria (45.30 mm) 47.84 PGI. Remaining, bio control agents were found least effective in inhibiting the mycelial growth of *L. theobromae* with 38.62 PGI in *B. subtilis* and 3.46 PGI in *P. fluorescens* at 7th day after incubation.

Thus, all the bioagents were found antagonistic against *L. theobromae.* significantly superior over control. The lowest mycelial growth and highest per cent growth inhibition was observed in *T. viride* which was found at par with *T. harzianum* seven days after incubation. Significantly next best treatment was rhizospheric actinobacteria. The least inhibitory activity was found in *B. subtilis* and *P. fluorescens* having significant difference in their antagonism.

The similar results to this investigation reported by Adeniyi et al. [9]. They tested *T. viride* and *Aspergillus niger* against *L. theobromae* causing inflorescence blight of cashew by different methods dual culture technique *in vitro.* In all techniques, *T. viride* exhibited antagonism against *L. theobromae*. In the pathogen at the centre technique, *T. viride* had 90.48 per cent growth inhibition. In case of effectivity of rhizospheric actinobacteria, Kamil et al. [10]. found that rhizosphere actinobacterial isolates were capable of producing strong anti-fungal metabolites active against *L. theobromae* which have produced large zones of pathogen inhibition (>30mm), and were considered as the most promising BCA candidates. Sinha et al [11]. also revealed that *Trichoderma* isolates produces various volatile and non-volatile compound which plays an important role in inhibition of *L. theobromae and L. pseudotheobroma.* The antagonistic effect of various isolates of *Trichoderma* sp. were also found to be antagonistic against mango die back pathogen *L. theobromae* [12].

Table 1. Bio-efficacy of antagonists on the mycelial growth of *L. theobromae in vitro*

	Name of Antagonists	Mycelial growth (mm)	Per cent growth inhibition (%)
T_1	*Trichoderma viride* NAU isolate	1.72 (24.80)	71.47
T_2	*Trichoderma harzianum* NAU isolate	1.83 (28.50)	67.15
T_3	*Pseudomonas fluorescens* NAU isolate	2.98 (83.80)	3.46
T_4	*Bacillus subtilis NAU* isolate	2.41 (53.30)	38.62
T_5	Rhizospheric actinobacteria	2.24 (45.30)	47.84
T_6	Control	3.03 (86.80)	0.00
S. Em. ±		0.04	
C.D. at 5%		0.11	
C.V. %		3.15	

(Figs. outside the parentheses are √X transformation values whereas figs. in parentheses are original values DAI: Days after inoculation.)

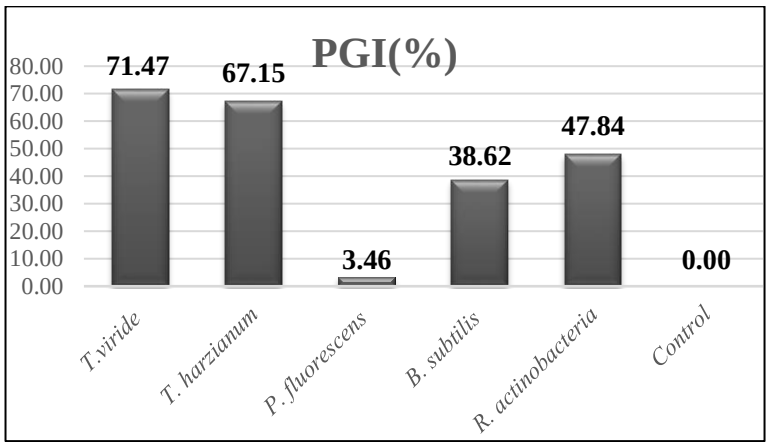

Fig. 1. Per cent growth inhibition of *L. theobromae* by various bio control agents *in vitro*

4. SUMMARY AND CONCLUSION

Based on present investigations, it is concluded that *T. viride* and *T. harzianum* have highest inhibitory property against *L. theobromae*. Therefore, they can be further explored under *in vivo* condition. Moderate antagonistic activity was seen in Rhizospheric actinobacteria and *B. subtilis*, *P. fluorescens* having lowest effect on the *L. theobromae*.

CONFERENCE DISCLAIMER

Some part of this manuscript was previously presented in the conference: ISMPP 42 Annual Conference and National Symposium on “Plant Health Management: A Way Forward for Food Safety, Security and Sustainability” (Golden Jubilee Celebration of ISMPP: 1970-2021) at Anand Agricultural University, Anand, Gujarat from May 10-12, 2023, Web Link of the proceeding: https://www.ismpp.org.in/wp-content/uploads/2023/10/53_02_Abstracts-1.pdf

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Torres-León C, Rojas R, Contreras-Esquivel JC, Serna-Cock L, Belmares-Cerda RE, Aguilar C N. Mango seed: Functional and nutritional properties. Trends in Food Sci. & Tech. 2016;55:109-117.
2. Anonymous. Third advance estimates of area and production of horticulture crops. Department of agriculture and farmer’s welfare, GOI. 2020;1.
3. Ragab MM, Sabet KA, Dawood NA. Botryodiplodia theobromae Pat. The cause of fruit rot and die back of mango in A.R.E. Agric. Rev. Cairo. 1971;49:81-97.
4. Ploetz CRL, Om, Prakash. Foliar, floral and soil borne diseases. In: The Mango (eds. Litz, R.E). CAB, International, Wallingford, UK. 1997;281-325.
5. Ploetz RC. Diseases of mango, in diseases of tropical fruit crops, ed R. C. Ploetz (St. Paul, MN: APS Press). 2003;327–363.
6. Dennis JC, Webster J. Antagonistic properties of species groups of trichoderma. Production of non-volatile antibiotics. Trans. Br. Mycol. Soc. 1971;57:25-39.
7. Reynolds J. Serial dilution protocols., American society for microbiology: Washington. 2005;1-7.
8. Asalmol MN, Sen B, Awasthi J. Role of temperature and pH in antagonism of Aspergillus niger and trichoderma viride against fusarium solani. Proc. Indian Phyto-Pathological Society (Western Zone). On Bio-control of Plant Pathogen. M.P.A.U., Pune.1990;11-13.
9. Adeniyi DO, Adedeji AR, Oduwaye OF, Kolawole OO. Evaluation of biocontrol agents against *Lasiodiplodia theobromae* causing inflorescence blight of cashew in Nigeria. J. Agric. Vet. Sci. 2013;5(3):46-48.
10. Kamil FH, Saeed EE, El-Tarabily KA, Abu Qamar SF. Biological control of mango dieback disease caused by *Lasiodiplodia theobromae* using streptomycete and non-streptomycete actinobacteria in the United Arab Emirates. Front. microbiol. 2018;9: 829.
11. Sinha B, Bui R, Sobita Devi Ph, Salam R, Dinesh K, Chakma T. *In vitro* Studies on efficacy of some plant extracts and biocontrol agents against *Lasiodiplodia theobromae* and Lasiodiplodia pseudotheobromae. Int. J. Curr. Microbiol. App. Sci. 2018;7(7):448-457.
12. Suresh V, Vidya Sagar B, Varma PK, Sumalatha N, Prasad MR. *In vitro* evaluation of certain fungicides, botanicals and bio control agents against *Lasiodiplodia theobromae*. Res. J. Agric. Sci. 2016;7(4/5):747-750.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/111580