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Evaluation of Different Bioagents *in vitro* against *Fusarium moniliforme* causing Mango Malformation

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ABSTRACT: Mango is an important fruit crop. This crop is suffering many diseases among them, mango malformation is economic important disease. Hence, present research work on "Symptomatology, Characterizations of *Fusarium* sp. causing mango malformation and its management" was carried out at Department of Plant Pathology, N. M. College of Agriculture, Navsari Agricultural University, Navsari (Gujarat) during the year 2021-2023. Mango (*Mangifera indica* L.) infested by many diseases, pests and physiological disorders. Among all diseases, mango malformation is a serious threat to this fruit crop in the growing countries. Five different bioagents *viz.*, *Trichoderma viride, T. harzianum, T. virens, P. fluorescens* and *B. subtilis* and T6- control were evaluation *in vitro* against *F. moniliforme* for growth inhibition of *F. moniliforme* by dual culture technique. Among them, the highest per cent growth inhibition was recorded *T. viride* (79.92%) followed by *T. harzianum* (78.51%) and *T. virens* (69.44%). The minimum growth inhibition was recorded in *B. subtilis* (48.30%).

Keywords: Mango malformation, *Fusarium* sp., Bioagents, *Trichoderma, Pseudomonas, Bacillus.*

INTRODUCTION

Mango (*Mangifera indica* L.) is unarguably one of the oldest and choicest tropical fruits of the world and is rightly designated as "King of all fruits". Mango belongs to the genus Mangifera and family Anacardiaceae is almost grown in all state of India. Tropical and sub-tropical areas favour the production of this crop (Das *et al.,* 2019). Mangoes originated in north-east India, Burma and Andaman Islands and bordering Bay of Bengal. The availability, acceptability and multipurpose utilization have adorned King's crown on mango. Hence, mango has been called as "The First Fruit of India". Major varieties grown in India are Alphonso, Dasheri, Langra, Bombay Green, Kesar and Chausa *etc.* It is an important fruit crop in area and production in Gujarat, where it is cultivated over an area of about 163.78 thousand hectares with annual production of 997.83 thousand MT with productivity of 6.09 MT/ha (Anon., 2022b). Its plantation has become quite popular in Gujarat the districts of Valsad, Junagadh, Navsari, Kutch, Surat, Amreli and Bhavnagar because of favourable agro-climate condition.

Mango crop infested from many diseases, pests and physiological disorders. Among all diseases/disorders, mango malformation is a serious threat to this fruit crop in most of the countries.

Biological control of plant diseases through the use of antagonistic micro-organisms is very promising strategy in sustainable agriculture (Adeleke *et al.,* 2019). Such concerns are driving the search for more environment friendly methods to manage plant disease that contribute to the goal of sustainability in agriculture. Use of antagonistic organisms in the bio control is a viable approach. Diverse microorganisms are also known to released metabolites that can interfere with pathogen growth and/or activities. Many microorganisms produce and release lytic enzymes that can hydrolyze a wide variety of polymeric compounds including chitin, proteins, cellulose, hemicellulose and DNA (Kumar and Verma 2020).

METHODOLOGY

To determine the antagonistic action of various known species of fungal and bacterial bioagents, the dual culture test was carried out (Dennis and Webster, 1971) at Dept. of Plant Pathology, NAU, Navsari. The growth suppression ability of T1- *Trichoderma viride,* T2- *T. harzianum,* T3- *T. virens,* T4- *P. fluorescens* and T5-*B. subtilis* and T6- control against *F. moniliforme* was examined by dual-culture technique. *F. moniliforme* was isolated from different malformed tissues by using potato dextrose agar (PDA) medium. Ten days old culture of different bio agents and the pathogen was

utilized. Twenty ml of media poured aseptically in each of the Petri plates and allowed to solidify. A 5 mm mycelial disc of ten days old culture of *F. moniliforme* was placed 10 mm away from the periphery of the Petri plate and on the opposite end 5 mm disc of four days old culture of biocontrol agent was placed at a distance of 10 mm from the periphery. A control having the test pathogen only was kept for comparison. Each treatment has 4 repetitions was taken. The Petri plates were incubated at 27±1°C till the *F. moniliforme* covered the medium surface in control. Radial growth of the *Fusarium* sp. in dual culture was recorded at 24 hrs interval. Observations on mycelia growth and per cent growth inhibition was recorded after 7 days of incubation. Index of antagonism was determined in each treatment by following standard formula as Asalmol *et al*. (1990).

$$I = \frac{C - T}{C} \times 100$$

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

RESULT AND DISCUSSION

Nowadays, farmers have switched to the use of eco-friendly methods for protecting crops from different fungal diseases. A bioagents colonizes the rhizosphere, the site that requires protection and leaves no toxic residues when compared to chemicals. *Trichoderma* sp. has been studied as a bioagent against soil–borne pathogenic fungi and reported that several strains of *Trichoderma* had a significant reducing effect against the plant diseases caused by *Fusarium* sp. Strains of *Trichoderma* can produce antifungal metabolites which check the growth of various fungi, act as competitors and promote plant growth.

The five fungal and two bacterial antagonists used in dual culture technique were evaluated for their antagonism against *F. moniliforme* under *in vitro* condition. The observations on mycelium growth and per cent growth inhibition (PGI) were recorded after eight days of incubation and the results obtained are presented in Plate 1, Fig. 1 and Table 1.

The results indicated that all the antagonists were significantly more effective in inhibiting the growth of *Fusarium moniliforme* over control. All the bioagents were able to check the mycelial growth of *F. moniliforme* either by over growing or by exhibiting inhibition zones. All antagonists inhibited more than 45 per cent growth of the *F. moniliforme*. Among them, significantly lower mycelia growth of the *F. moniliforme* was observed in *T. viride* (18.07 mm) which was at par with *T. harzianum* (19.34 mm). Next best in order of merit was *T. virens* (27.50 mm) followed by *Pseudomonas fluorescens* (45.71mm) which was at par with *Bacillus subtilis* (46.53 mm) produced comparatively higher mycelia growth. Likewise, maximum per cent growth inhibition of the *F. moniliforme* was observed in *T. viride* (79.92 %) which was at par with *T. harzianum* (78.51%). *T. virens* was also found with 69.44 per cent reduction in growth of followed by *P. fluorescens* and *B. subtilis* recorded least effective as compare to the other fungal bio agents exhibiting 49.21 and 48.30 per cent growth inhibition, respectively over control. In general, fungal bio control agents were more effective in inhibiting mycelia growth of the *F. moniliforme* as compared to bacterial bio control agents.

Similar results were shown by Malik *et al.* (2018) they tested three bio-agents of *Tricoderma* against *F. mangiferae.* Among bio-control agents, *T. harzianum* gave maximum growth inhibited 71.00 per cent against *F. mangiferae.* Maari *et al.* (2015) studied on efficacy of *T. harzianum* to find out the suitable and eco-friendly approaches management of disease under *in vitro* condition. They revealed that *T. harzianum* was found significant in suppressing the mycelial growth of the *F. nivale* causing mango malformation. In general, all the three bioagents were effective in reduced the growth of *Fusarium* sp. Similar results also were reported by Veldman *et al.* (2018).

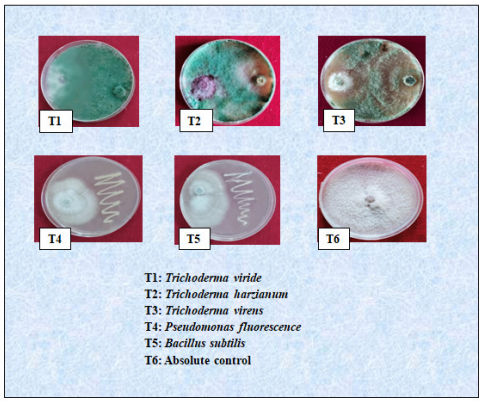

Plate 1. Growth inhibition of *Fusarium moniliforme* on PDA with different bioagents *in vitro.*

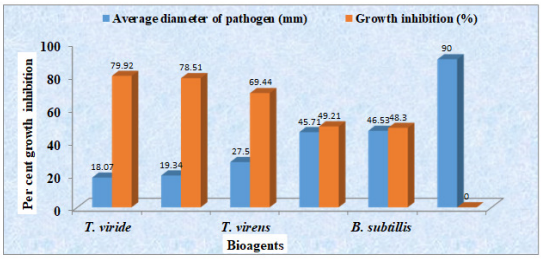

Fig. 1. Efficacy of different bioagents against *Fusarium moniliforme in vitro.*

Table 1: Evaluation of different bioagents against *Fusarium moniliforme in vitro*.

Sr. No.	Bio agents	Avg. diameter of *F. moniliforme* (mm)	Per cent growth inhibition (%)
1.	*Trichoderma viride*	18.07 (25.18)[a]	79.92
2.	*Trichoderma harzianum*	19.34 (26.08)[a]	78.51
3.	*Trichoderma virens*	27.50 (32.37)[b]	69.44
4.	*Pseudomonas fluorescens*	45.71 (42.57)[c]	49.21
5.	*Bacillus subtilis*	46.53 (43.31)[c]	48.30
6.	Control	90.00 (71.54)[d]	0.00
S. Em.±		**0.49**	
C. D. at 5 %		**1.47**	
C.V. %		**2.45**	

@ Mean of four repetitions
Figures in parenthesis are arc sign transformed values and outside parenthesis are original values

CONCLUSIONS

From this study, concluded that the fungal bioagent *Trichoderma* isolates were proved most effective than bacterial bioagent. Among them, the highest growth inhibition was recorded *T. viride.* The least growth inhibition was recorded in *B. subtilis* was proved less effective as compare to fungal bioagents over control.

FUTURE SCOPE

We can focus on use of bioagents instead of chemical fungicides because it has been most emphasized and widely accepted practice as it is environmentally safe and can overcome the residual problems associated with huge use of fungicides for management of disease.

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