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Bio-efficacy of different bio-control agents (BCA) against wilt (*Fusarium solani*) of pointed gourd *in vitro*

Payal R Patel, SK Chawda and Prerak M Patel

Abstract
Pointed gourd (*Trichosanthes dioica* Roxb.) is an annual or perennial herbaceous vine commonly known as pointed gourd (English), Putulika (Sanskrit), Parval (Hindi), Patola (Gujarati) and Patol (Bengali). It is called 'King of gourds' because of its higher nutrient content than other cucurbits and it belongs to family Cucurbitaceae**.** It is one of the most important cucurbit crops of South Gujarat particularly in Olpad, Mahuva and Chikhli block of Surat district. The pointed gourd is adversely affected by several abiotic and biotic factors including insects, pests, bacteria, nematode and fungi in varying proportions. It is also attacked by number of diseases at all stages of crop growth. Among them, wilt of pointed gourd caused by *Fusarium solani* (Mart.) Sacc. is one of the major threats to profitable cultivation in south Gujarat. Six different bio control agents were evaluated *in vitro* by dual culture method against the *F. solani*, which inhibited the growth of pathogen by 41.41 to 72.33 percent. The fungal bio control agent *Trichoderma* isolates were proved most effective than bacterial isolates. Among them *Trichoderma* isolates *T. harzianum* followed by *T. viride* showed most promising results compared to others. The highest growth inhibition of *F. solani* was recorded by *T. harzianum* (72.33%) followed by *T. viride* (70.81%). The least growth inhibition was recorded in *Chaetomium globosum* (41.41%). *Pseudomonas fluorescens* (65.48%) and *Bacillus subtilis* (56.81%) were proved less effective as compare to fungal bio agents.

Keywords: Perennial, cucurbitaceae, abiotic and biotic, biocontrol agents, *Fusarium solani*, *in vitro*, dual culture, *Trichoderma*, *Chaetomium globosum*, *Pseudomonas fluorescens*

Introduction
Pointed gourd (*Trichosanthes dioica* Roxb.) is an annual or perennial herbaceous vine commonly known as pointed gourd (English), Putulika (Sanskrit), Parval (Hindi), Patola (Gujarati) and Patol (Bengali). The centre of origin is Bengal-Assam area or Indo- Malayan region. It is called 'King of gourds' because of their higher nutrient content than other cucurbits and it belongs to family Cucurbitaceae (Mondal *et al.*, 2014) [14]. It is one of the most important cucurbit vegetables in Asian tropical and subtropical regions of the world, particularly in India and in Bangladesh also in Pakistan, Myanmar, Nepal and Sri Lanka. It is extensively cultivated in Eastern Indian states particularly in Bihar, Eastern Uttar Pradesh, West Bengal, Assam, Tripura and to some extent in Orissa (Khare, 2004) [13]. Its fruit is good for curing heart and brain disorders, has diuretic and laxative properties and is also cardio tonic. It is recommended against bronchitis, biliousness, high fever and nervousness. As per the third advance estimate of the National Horticultural Board 2020-21, pointed gourd is growing on 55 thousand hectares area and produced 740 thousand MT in India. In India, Total area under pointed gourd cultivation is 20 thousand hectares with an annual production of 325 thousand tonnes (Anon., 2021) [1]. Like other crops, pointed gourd is adversely affected by several abiotic and biotic factors including insects, pests, bacteria, nematode and fungi in varying proportions. Fusarium wilt is one of the major destroyer diseases. It is a cosmopolitan soil borne fungus with both saprophytic and pathogenic members. It is characterized by drying of vines, leaves and fruits, yellowing and drooping of the leaves, discolouration and later stage completely wilting.
Managing fusarium wilt is very difficult because of the persistent nature of chlamydospores (10 to 15 years) and the development of new physiological races (Rahman *et al.*, 2021) [15]. Chlamydospores are the primary means of survival and typically form under conditions of suboptimal growth for the fungus or death of the host plant. However, to control fusarium wilt disease, different strategies are currently being employed in agriculture. One of these is use of biological agents are an effective and sustainable alternative approach to control the growth

and reproduction of fusarium pathogen. Various species of *Trichoderma*, *Pseudomonas* and *Gliocladium* had been studied for their bio-control ability against plant disease caused by *Fusarium* spp. therefore, biological management to keep the disease below economic injury level as long term measure. In this context, the present study was planned for the management of wilt of pointed gourd by the use of bio- agent.

Materials and Methods

The pathogen was isolated from diseased pointed gourd root. The test organism and pathogen was grown separately on PDA medium. Bio-agents *i.e*. *Trichoderma viride*, *T. harzianum*, *Pseudomonas fluorescens*, *Bacillus subtilis*, *Chaetomium globosum* and *Aspergillus niger* were brought from department of plant pathology.

Antagonistic activity of the bio-agents against test pathogen was determined by "dual culture technique" by Dennis and Webster (1971) [6]. 5 mm mycelial disc of pathogen was taken from the actively growing colonies of the test pathogen and antagonist with help of sterilized cork borer. The disc of the pathogen was placed on one side in agar plates aseptically and the disc of antagonists was placed opposite side, the pathogen in same plate. Each treatment was replicated three times and incubate at 28 ± 1 °C. Growth of antagonists and pathogen were recorded at 24 hours interval after incubation till the colony in the control plate covered with mycelium of pathogen. Inhibition zone was measured at 24 hours interval till the colony in the control plate covered with mycelium of pathogen. The percent growth inhibitions (PGI) of pathogen in each treatment were calculated by following formula given by Bell *et al.* (1982) [2].

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

Where,
I = Antagonist index,
C = Colony diameter (mm^2) in control plate,
T = Colony diameter (mm^2) in treated plate

Table 1: List of different bio control agents used against *Fusarium solani in vitro*

Treatment No.	Bio control agents
T_1	*Trichoderma viride* (NAU isolate)
T_2	*Trichoderma harzianum* (NAU isolate)
T_3	*Pseudomonas fluorescens* (NAU isolate)
T_4	*Bacillus subtilis* (NAU isolate)
T_5	*Chaetomium globosum* (NAU isolate)
T_6	*Aspergillus niger* (NAU isolate)
T_7	Control

Design: CRD

Treatment: 07

Replication: 03

Location: Dept. of Plant Pathology, P.G. Laboratory, N.A.U., Navsari.

Result and Discussion

In vitro evaluation of different native isolated antagonists under dual culture technique revealed growth inhibition of test fungus (*Fusarium solani*) by the test antagonists *viz.*, *Trichoderma viride*, *T. harzianum*, *Pseudomonas fluorescens*, *Bacillus subtilis*, *Aspergillus niger* and *Chaetomium globosum.* Based on observations of radial growth of antagonist and test fungus, percent inhibition was calculated. The observations regarding percent inhibition was presented in Table 2 and depicted in Photo 1 with figure 1.

The results revealed that all antagonists showed different results. It is evident from the data presented in Table 2 that all the bio control agents were able to check the mycelial growth of *F. solani* either by over growing or by exhibiting inhibition zones. All antagonists inhibited more than 50 percent growth of the test fungus except *Chaetomium globosum*. In general, fungal bio control agents were more effective in inhibiting mycelia growth of the test pathogen as compared to bacterial bio control agent. Minimum radial mycelia growth of the pathogen (*F. solani*) was observed in *Trichoderma harzianum* (24.90 mm) followed by *T. viride* (26.27 mm). Likewise, maximum percent mycelia inhibition of the pathogen was observed in *T. harzianum* (72.33%) followed by *T. viride* (70.81%). The *Aspergillus niger* was also found better with 27.90 mm radial mycelia growth and 69.00 percent reduction in growth of pathogen. *Chaetomium globosum* was recorded least effective as compare to the other bio-agensts exhibiting radial mycelia growth of pathogen 52.73 mm and 41.41 percent mycelia inhibition over control. Among the bacterial antagonists *Pseudomonas flueroscens* showed 31.07 mm mycelia growth of the pathogen and 65.48 percent inhibition growth over control followed by *Bacillus subtilis* recorded 38.87 mm diameter mycelia growth and 56.81 percent inhibition over control.

Similar results were recorded by Gurjar *et al.* (2004) [9], Joshi and Raut (2005) [12] and Chakraborty and Chatterjee (2008) [3]. They reported that *Trichoderma harzianum* showed strong antagonistic activity toward *F. solani in vitro* conditions. Chavan and Hegde (2009) [4] reported that maximum inhibition of mycelia growth of *F. Solani* was noticed in *T. harzianum.* Various workers *viz.*, Dubey and Suresh (2006) [7], Joshi and Harsh (2009) [11], Gupta *et al.* (2011) [8], Jambhulkar *et al.* (2011) [10] and Choudhary and Mohanka (2012) [5] found *Trichoderma* spp. more effective against *Fusarium* spp.

Table 2: Percent growth inhibition of *Fusarium solani* by different bio control agents (BCA) through dual culture technique

Sr. No.	Treatment	Bio control agents	Colony diameter of pathogen (mm)	Growth inhibition over control (%)
1.	T_1	*Trichoderma viride* (NAU isolate)	26.27 (30.83)	70.81
2.	T_2	*Trichoderma harzianum* (NAU isolate)	24.90 (29.93)	72.33
3.	T_3	*Pseudomonas fluorescens* (NAU isolate)	31.07 (33.86)	65.48
4.	T_4	*Bacillus subtilis* (NAU isolate)	38.87 (38.56)	56.81
5.	T_5	*Chaetomium globosum* (NAU isolate)	52.73 (46.56)	41.41
6.	T_6	*Aspergillus niger* (NAU isolate)	27.90 (31.88)	69.00
7.	T_7	Control	90.00 (71.56)	0.00
	SEm±		0.44	
	CD at 5%		1.32	
	CV%		1.86	

*Values are mean of three replications
*Figures in parenthesis are arc sign transformed values while outside are original values

T_1: *Trichoderma viride* (NAU isolate)
T_2: *Trichoderma harzianum* (NAU isolate)
T_3: *Pseudomonas fluorescens* (NAU isolate)
T_4: *Bacillus subtilis* (NAU isolate)
T_5: *Chaetomium globosum* (NAU isolate)
T_6: *Aspergillus niger* (NAU isolate)
T_7: Control

Photo 1: Percent growth inhibition of *F. solani* by different bio agents *in vitro*

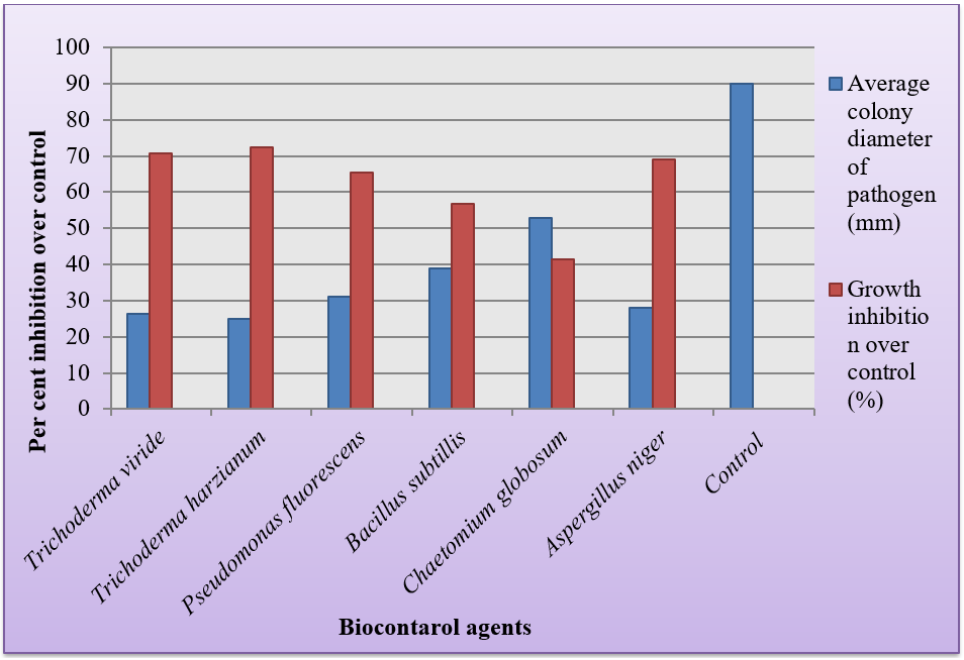

Fig 1: Growth inhibition of *F. solani* by different bio-control agents (BCA) *in vitro*

Conclusion

Six different bio control agents were evaluated *in vitro* by dual culture method against the *F. solani*, which inhibited the growth of pathogen by 41.41 to 72.33 percent. The fungal bio control agent *Trichoderma* isolates were proved most effective than bacterial isolates. Among them *Trichoderma* isolates *T. harzianum* followed by *T. viride* showed most promising results compared to others. The highest growth inhibition of *F. solani* was recorded by *T. harzianum* (72.33%) followed by *T. viride* (70.81%). The least growth inhibition was recorded in *Chaetomium globosum* (41.41%). *Pseudomonas fluorescens* (65.48%) and *Bacillus subtilis* (56.81%) were proved less effective as compare to fungal bio agents.

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