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In vitro efficacy of Biocontrol Agents Against *Phytophthora drechsleri* Tucker f. sp. *cajani*, causing Stem Blight Disease of Pigeonpea

J.B. Bhalerao[1], P.H. Ghante[2], S.N. Banne[1], J.D. Sirsat[1], P.B. Bhalerao[3] and S.S. Kadam[1]*
[1]Ph.D. Research Scholar, Department of Plant Pathology,
Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani (Maharashtra), India.
[2]Associate Professor, Department of Plant Pathology,
College of Agriculture, Dharashiv (Maharashtra), India.
[3]Ph.D. Research Scholar, Department of Plant Pathology and Agricultural Microbiology,
Mahatma Phule Krishi Vidyapeeth, Rahuri (Maharashtra), India.

(Corresponding author: J.B. Bhalerao)*
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ABSTRACT: Pigeonpea [*Cajanus cajan* (L.) Millspaugh] is a significant grain legume crop grown in India and prone to many diseases. Among different diseases of pigeonpea, stem blight caused by *Phytophthora drechsleri* tucker f. sp. *cajani* is one of the most important disease and causes drastic losses in crop yield. *P. drechsleri* tucker f. sp. *cajani* is soil borne pathogen and difficult to manage by use of fungicides alone. Therefore, *in vitro* study was attempted to evaluate the *in vitro* efficacy of nine potent bioagents *viz*., *Trichoderma asperellum*, *T. harzianum*, *T. koningii*, *T. virens*, *T. hamatum*, *T. longibrachiatum*, *Bacillus subtilis*, *Pseudomonas fluorescens* and *Aspergillus niger* against *P. drechsleri* tucker f. sp. *cajani*, during 2021-22, at the Department of Plant Pathology, VNMKV, Parbhani. All bioagents were found antagonistic to the fungus, but most efficient was, *T. harzianum*, resulted with significant maximum mycelial growth inhibition (81.87 %), of the test pathogen. The second and third inhibitoriest antagonists found were *T. asperellum* and *A. niger* with the inhibition of 72.00 % and 70.72 %, respectively.

Keywords: Pigeonpea, *Phytophthora* blight, Inhibition, Bioagents.

INTRODUCTION

Pigeonpea [*Cajanus cajan* (L.) Millspaugh] is an important legume in tropical and subtropical regions. It is also known by several dialects and trade names such as red gram, tur, Angolan pea, Congo pea, yellow dhal and oil dhal. Pigeon pea is the richest source of protein, making it a recommended addition to a balanced cereal diet, especially in the absence of protein (21% in green seeds, 18.8% in mature seeds and 24.6% in dhal) and essential amino. Acids such as methionine, lysine and tryptophan. In the world, it is cultivated on approximately 4.58 million hectares and the production is 3.27 million tons. Pigeonpea, a *Kharif* crop native to Maharashtra, is grown in marginal areas because it can grow in water and nutrient-stressed soils. Despite the high yield potential (2000-2500 kg/ha), the actual yield is lower due to low productivity and poor management. Pigeon pea is grown mainly as an intercrop with other plants that do not receive full attention.

In addition, crops face many biotic and abiotic factors that limit its true productivity. More than 160 pathogens carry diseases to pigeon, which is a major risk in cultivation. More than 63 fungal, 3 bacterial, 19 viral or similar pathogens and 10 nematodes have been reported to infect crops at different growth stages. Few diseases in India cause significant yield loss and are economically important. The spectrum and intensity are different in different agro-climatic regions and growing situations. Fusarium wilt, sterility mosaic disease and phytophthora blight are the most common and economically important diseases in Maharashtra.

The first suspicion of *Phytophthora* blight in pigeonpea was reported by Williams *et al*. (1968). Although disease control with chemicals is very effective, growing concern about pesticide toxicity has prompted a search for alternatives. In that direction, biological control is considered to be environmentally friendly and a good alternative to sustainable agriculture to address public concerns about pathogens resistant to pesticides and chemical pesticides (Akhtar and Siddiqui 2008). The use of bioagents can reduce the emergence of insecticide-resistant pathogenic strains, which have become a major problem worldwide (Utkhede and Smith 1992).

Therefore, the use of bioagents for disease control appears to be an environmentally friendly, cost-effective and promising alternative to chemical disease control. Therefore, this study was conducted to evaluate the *in vitro* efficacy of effective bioagents against *P. drechsleri* Tucker f. sp. *cajani*, which causes stem blight disease of pigeonpea.

MATERIALS AND METHODS

A total seven fungal antagonists *viz*., *Trichoderma asperellum*, *T. harzianum*, *T. hamatum*, *T. longibrachiatum*, *T. virens*, *T. koningii*, *Aspergillus niger* and two bacterial antagonists *i.e., Pseudomonas fluorescens* and *Bacillus subtilis* were evaluated *in vitro* against *Phytophthora drechsleri* f. sp. *cajani*, applying dual culture technique (Dennis and Webster 1971). Seven days old cultures of the test bioagents and test fungus (*P. drechsleri* f. sp. *cajani*) grown on Potato Dextrose Agar (PDA) were used for the study. Discs (5 mm diam.) of PDA along with culture growth of the test fungus and bioagents were cut out with sterilized cork borer. Then two culture discs, one each of the test fungus and bioagent were placed at equi-distance and exactly opposite with each other on solidified PDA medium in Petri plates aseptically. Plates were incubated at 27 ± 2 ^{0}C. PDA plates inoculated only with culture disc of the fungus were maintained as untreated control. The experimental details were as given below.

Experimental details

Design : CRD

Replications : Three

Treatments : 10

Treatment details

Tr. No.	Treatments
T_1	*Trichoderma asperellum*
T_2	*Trichoderma harzianum*
T_3	*Trichoderma koningii*
T_4	*Trichoderma virens*
T_5	*Trichoderma hamatum*
T_6	*Trichoderma longibrachiatum*
T_7	*Bacillus subtilis*
T_8	*Pseudomonas fluorescens*
T_9	*Aspergillus niger*
T_{10}	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. Percent inhibition of the test fungus by the bioagents over untreated control were calculated by applying following formula (Arora and Upaddhyay 1978).

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

RESULTS AND DISCUSSION

The results presented in (Table 1, Plate I and Fig. 1) demonstrate the *in vitro* effectiveness of various bioagents in reducing the mycelial growth of *P. drechsleri* f. sp. *cajani,* a fungal disease that affected crops. The 10 treatments and associated pathogen colony diameters, as well as % 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 *P. drechsleri* f. sp. *cajani*.

Tr. No.	Treatments	Colony Dia. (mm) of Pathogen	% Inhibition
T_1	*Trichoderma asperellum*	25. 20	72.00 (58.17)
T_2	*Trichoderma harzianum*	16.32	81.87 (65.26)
T_3	*Trichoder makoningii*	31.00	65.56 (54.07)
T_4	*Trichoderma virens*	28.65	68.17 (55.75)
T_5	*Trichoderma hamatum*	27.32	69.64 (56.66)
T_6	*Trichoderma longibrachiatum*	33.00	63.33 (52.78)
T_7	*Bacillus subtilis*	54.32	39.64 (39.01)
T_8	*Pseudomonas fluorescens*	41.24	54.18 (47.40)
T_9	*Aspergillus niger*	26.35	70.72 (57.35)
T_{10}	Control (Untreated)	90.00	00.00 (0.00)
	SE±	**1.13**	**0.39**
	CD at 1 %	**3.32**	**1.14**

Among the antagonists tested, highest colony diameter (54.32 mm) of the test pathogen was found in *B. subtilis*. The second highest colony diameter was found in *P. fluorescens* (41.24 mm). They were followed by *T. longibrachiatum (*33.00 mm), *T. koningii* (31.00 mm), *T. virens* (28.65 mm), *T. hamatum* (27.32 mm), *A.niger* (26.35 mm), *T. asperellum* (25.20 mm) and *T. harzianum* (16.32 mm) (Table 1).

Of the antagonists tested, *T. harzianum* was found most significant with highest mycelia growth inhibition (81.87 %) of the test pathogen. The second and third inhibitoriest antagonists found were *T. asperellum* and *A.niger* with inhibition of 72.00 % and 70.72 %, respectively. These were followed by *T. hamatum* (69.64 %), *T. virens* (68.17 %), *T. koningii* 65.56 %), *T. longibrachiatum* (63.33 %), *P. fluorescens* (54.18 %) and least inhibition of pathogen was observed in *B. subtilis* (39.64 %). Thus, the bioagents *viz*., *T. harzianum, T. asperellum* and *A.niger* were found most potential antagonists against *P. drechsleri* f. sp. *cajani*

The results of present investigation resembling the finding of earlier worker, Ambadkar and Jadhav (2007) used a dual culture technique to evaluate the efficacy of *Trichoderma* spp. in inhibiting the growth of *Phytophthora* spp. At 72 hrs of incubation the highest percent inhibition of mycelial growth of *Phytophthora nicotianae* was recorded in the treatment of *T. harzianum* (48.71%). The highest percent inhibition of *Phytophthora citrophthoora* was recorded in the treatment of *T. viride* (45.30%) at 72 hrs of incubation, followed by *T. lignomm* (40.88%) and *T. harzianum* (38.12%). Vijayaraghavan and Koshy (2007) evaluated the efficacy of efficient antagonist from black pepper nurseries and use them alone or in the combination with soil solarization fungicides in the integrated management of *Phytophthora* diseases in black pepper nursery. Among the different native fungal isolates, two were found to be effective and were identified as *Trichoderma viride* and *Trichoderma longibrachiatum* observations on the incidence and severity of *Phytophthora* tot in black pepper nursery found that in general soil solarization, application of native fungal antagonists and spraying of Ridomil MZ had a favourable effect in evaluating the disease. It was also found that solarization of potting mixture and application of *Trichoderma* spp. and a positive effect in minimizing the mortality of cuttings.

Plate I: *In vitro* efficacy of different bioagents against *P. drechsleri* f.sp.*cajani.*

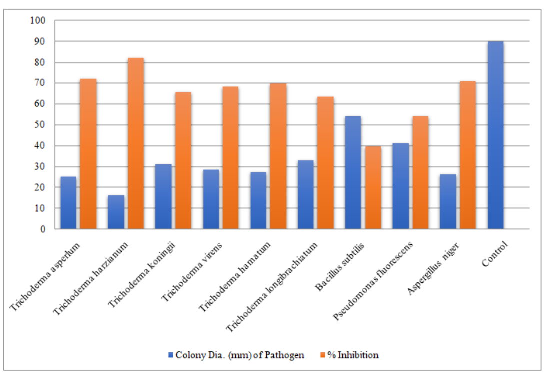

Fig. 1. *In vitro* efficacy of different bioagents against *P. drechsleri* f. sp. *cajani.*

CONCLUSIONS

Biocontrol agents such as *T. harzianum, T. asperellum* and *A. niger* proved to be potential antagonist could be extensively employed to manage several plant diseases/pathogens, including *P. drechsleri* f. sp. *cajani.*

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