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International Journal of Research in Pure and Applied Microbiology

ISSN 2277–3843

Original Article

Host range study of turmeric rhizome rot pathogen *Pythium aphanidermatum* on selected Zingiberaceae members

K. Anoop [1*], R. Suseela Bhai[2]

[1&2]Division of Crop Protection, Indian Institute of Spices Research, Calicut, Kerala

*Corresponding author, Email: anoopkuttiyil@gmail.com

Received 08 October 2013; accepted 24 October 2013

Abstract

Pythium aphanidermatum (Edson) Fitzp. belonging to Oomycetes is a well known devastating pathogen of many vegetables, fruits, grasses and ornamental crops in several parts of the world with a wide host range. It is also known to cause rhizome rot disease in turmeric. Disease management approaches like intercropping may not become a failure against pathogens with wide host range. The host range of *P. aphanidermatum* pathogenic to turmeric was studied on five members of Zingiberaceae viz., *Curcuma zeodaria, C. amada, C. aromatica, C. cassie and Zingiber officinale* which are crop rotated with turmeric in different turmeric growing tracts of Palakkad and Wayanad districts of Kerala. Among the crops tested, *C. amada* and *C. cassie* showed no symptoms till the end of the season by the most virulent isolate of *P. aphanidermatum* pathogenic to turmeric. *C. zeodaria and Z. officinale* were found to be more susceptible and showed symptoms within 7 days after inoculation. Cultivation of these two crops immediately after *C. longa* or vice versa may lead to crop loss in the upcoming season due to the survival of the pathogen in soil and its wide host range. Thus this information will be useful to take up the disease management with a non host crop.

Keywords: *Pythium aphanidermatum*, rhizome rot, pathogen, host-range, Turmeric

1. Introduction

The genus *Pythium* belongs to the class Oomycetes of Kingdom Stramenopila. *Pythium* is a serious pathogen of many vegetables, fruits, grasses and ornamental crops in several parts of the world [1, 2]. They cause the damping off of economically important crops like pea (*Pisum sativum* L.), sugar beet (*Beta vulgaris* L.), cucumber (*Cucumis sativus* L.) and root rot in horticultural crops like tomato (*Lycopersicum esculentum* Mill.) and cucumber (*Cucumis sativus* L.) [3, 4, 5]. *Pythium aphanidermatum* (Edson) Fitzp. is a serious pathogen in many horticultural crops in warmer areas with a broad host range [2]. A pathogen with wide host range can survive over several seasons of cultivation symptomatically or asymptomatically on its host plants. One of the most useful approaches of disease management to this problem is crop rotation. But the susceptibility of the rotated crop to this pathogen may lead to failure of the crop production. Hence the information regarding the host range of the pathogen over rotated crop will be helpful for the better management of the disease.

Turmeric, the 'golden spice' is prone to diseases like rhizome rot caused by *P. aphanidermatum* [6] and the crop is often rotated with some other Zingiberaceae members like *Curcuma zeodaria, C. amada, C. aromatica, C. cassie* and *Zingiber officinale* in some turmeric growing tracts of Palakkad and Wayanad district of Kerala. The crops like *Zingiber officinale* are also reported to have diseases like rhizome rot caused by *Pythium* spp. [7]. The role of these crops in the survival of the pathogen may be the cause the cause of rhizome rot disease of turmeric in the next cropping season. So the present study was undertaken to study the host range of *P. aphanidermatum* pathogenic to turmeric on the above mentioned members of Zingiberaceae for the better management of the disease.

2. Materials and Methods

2.1. Inoculum Preparation

One of the virulent isolates of *Pythium aphanidermatum* pathogenic to turmeric was tested for host range studies on five members of Zingiberaceae *viz., C. zeodaria, C. amada, C. aromatica, Z. officinale and C. cassie* along with *C. longa.* The healthy rhizomes of these plants were planted in polybags filled with sterile potting mixture containing soil, sand and farm yard manure (1:1:1) and grown under green house conditions. *P. aphanidermatum* isolate was cultured in Potato Dextrose Broth in Roux bottles using mycelial plugs (3 mm) taken from the advancing margin of 7 day old pure culture of the isolate. The culture was allowed to grow at 25^{O}C± for 5 days and the mycelial mat thus grown was used for pathogenicity

tests. The mycelial mats thus formed were harvested, weighed and homogenized in a mixer blender and made into a suspension. This suspension at 5ml containing 1g ml^{-1} was inoculated over the soil surface around one month old healthy plants. The plants without inoculum served as control [8]. Six replications were kept for each crop. The plants were evaluated for the development of water soaked lesions on pseudo stem and subsequent yellowing of the leaves. The rhizome rot symptoms showed by these plants were observed carefully and were recorded at regular intervals.

2.2 Reisolation of the pathogen

The plants which showed symptoms of rhizome rot were collected and used for the reisolation of the pathogen to prove the pathogenicity. The infected samples were brought to the laboratory and the infected portions including pseudo stem, roots and rhizomes were used for isolation. These were washed thoroughly with tap water to remove the adhered soil. Small bits excised from the diseased portions along with some healthy portions were surface sterilized with 10% NaOCl or with 75% ethanol for 1-3 min and then washed in three changes of sterile distilled water and transferred onto Potato Dextrose Agar (PDA) in 90 mm petriplates.

2.3 Baiting techniques

The soil samples from polybags of infected plants were collected and used for baiting. About 50 g of soil was transferred to disposable glasses containing 50 ml of sterile water. The soil suspension was stirred well using a glass rod to make it uniform. About 10 leaf discs of *Bauhinia variegata* were placed as baits on the surface of the soil suspension and incubated for 72 h at 25 ± 1 ºC. The mycelia grown on the leaf discs were observed microscopically and were transferred to PDA plates for purification and further identification.

2.4 Identification of pathogen

The hyphal tips growing on PDA were excised and transferred onto media *viz*. PDA, CMA, Potato Carrot Agar (PCA) and Tomato Extract Agar (TEA) to produce the reproductive structures as described by van der Plaats Niterink [2] and Waterhouse [9]. They were studied in detail for sporangia formation and production of sex organs. The cultures were observed microscopically using Nikon Eclipse E600 Trinocular Research Microscope.

3. Results

Out of the five members tested to study the host range of the pathogen, *C. zeodaria* and *Z. officinale* developed symptoms of rhizome rot within seven days of inoculation. *Z. officinale* was the first to show symptoms of the disease within 5 days. Variations in the occurrence of symptoms were noted among the plants tested. *Z. officinale* was found more susceptible showing lesions on pseudo stem and yellowing of the leaves. The younger leaves turned yellow within seven days. Those plants showed 100% disease incidence (DI) within 7 days. In *C. zeodaria*, the lesions on pseudo stem and yellowing of the lower leaves were not as prominent as in *Z. officinale* after 5 days. The symptoms showed after seven days were typically as in the case of *C. longa*. It showed 83.33% DI on 5th day after inoculation (DAI) but became 100% on 7th DAI. In *C. longa* the initial symptom like lesions on the lower leaf was noted on 7th DAI. The lower leaves and pseudo stem showed water soaked lesions which caused complete collapse of the pseudo stem after 10 days. *C. zeodaria* also showed similar symptoms and 100% DI within 7 days. In *C. aromatica* the symptoms of rhizome rot were noted only on 12th DAI and showed 100% DI on 14th DAI. The rhizomes of the infected plants were used for re-isolation of the pathogen. *C. amada* and *C. cassie* did not develop any symptoms of infection till the end of the season. The soil samples of these plants were taken for baiting to detect the presence of pathogen in the soil. The infected leaf discs of *Bauhinia variegata* were observed microscopically and the pathogen was identified morphologically as described by van der Plaats Niterink [2] and Waterhouse [9].

Table1. Pathogenicity of *P. aphanidermatum* on Zingiberaceae members

Crop	Reaction	7th day	14th day
Curcuma longa	++*	**83.33**	**100**
C. zeodaria	+++	**100**	**100**
C. amada	-	**0**	**0**
C. aromatica	++	**83.33**	**100**
C. cassie	-	**0**	**0**
Zingiber officinale	+++	**100**	**100**

*+++ Infection within 5 days, ++ Infection with in 7-15 days, - No infection

4. Discussion

The rotation of crops is considered as an effective and most economical practice for disease management. Although it is useful it will not be effective if the crop used for rotation is an asymptomatic host for the pathogen. Hence for the selection of non host plants, it is necessary to study the host range of the pathogens of the crops and its survival. Such reports over the pathogen are helpful in successful rotation of the crops and thereby in disease management. In the present study, the host range study is restricted to members of the family Zingiberaceae since they are rotated with turmeric in Palakkad and Wayanad districts. of Kerala. In the present study *Z. officinale*, *C. zeodaria* and *C. amada* were found to be hosts for *P. aphanidermatum* causing rhizome rot in *C. longa*. Hence, the practice of crop rotation with these crops may lead to loss in turmeric cultivation. From the results it is clear that *Z. officinale* and *C. zeodaria* are more susceptible to the pathogen. Similarly *Pythium* spp. is an already established pathogen of *Z. officinale* causing rhizome rot [7]. Hence rotation between these two crops may cause heavy loss for both the crops. This is supported by the findings of Davison and McKay [10]. They pointed out the importance of rotation of non host broccoli plants with host plant carrot to avoid *P. sulcatum* infection. Tian and Babadoost [11] studied the host range and virulence of *Phytophthora capsici* isolates from pumpkin cultivars. They reported five crop species as hosts of *P. capsici* for first time. Romberg and Davis [12] reported pepper as a symptomless host for *F. solani* that causes foot rot in tomato and wilt of potato. Schrandt *et al.* [13] studied the host range of *Pythium* sp. from carrot and identified six new symptomless hosts in

greenhouse pathogenicity tests. Though the present study is preliminary to conclude the host range of *P. aphanidermatum*, the information from the present work does provide valuable leads and will be useful for the farmers who practice crop rotation with turmeric.

5. Acknowledgements

The author thankfully acknowledges University Grants Commission for the financial support**.**

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Source of support: Nil; Conflict of interest: None declared