

Research Article

## Phytophthora foot rot (*Phytophthora capsici* Leonian.) of black pepper management through fungi toxicant and consortium in western Ghats of Karnataka

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### ARTICLE INFO

Article Chronicle :

Received : 12.01.2012

Revised : 18.02.2012

Accepted : 21.03.2012

Key words :

Potassium phosphonate, *Trichoderma harzianum* (MTCC-5179), Consortium, Black pepper

### ABSTRACT

Phytophthora foot rot (*Phytophthora capsici* Leonian) of black pepper could be managed effectively by application to vines with potassium phosphonate (@ 0.3 per cent) as spraying (@ 2 l<sup>-vine</sup>) and drenching (3 l<sup>-vine</sup>) and bioagent *Trichoderma harzianum* 50 g with one kg of neem cake as soil application during first week of June and third week August to the root zone. The protected vines exhibited minimum leaf yellowing, least defoliation, minimum death of vines and highest yield (green berry yield and projected yield). However, bioagents application i.e., Consortium of bacteria @ 10<sup>8</sup> cfu/g (for growth, nematode and Phytophthora suppression – IISR-6 and IISR 859) as spraying (@ 2 l<sup>-vine</sup>) and drenching (@ 3 l<sup>-vine</sup>) and *Trichoderma harzianum* (MTCC 5179) 50 g with one kg of neem cake as soil application around the root zone of the vine twice (June and August) also significantly reduced the disease with respect to less leaf infection, less yellowing, less defoliation and less death of vines.

**How to view point the article** : Lokesh, M.S., Patil, S.V., Gurumurthy, S.B., Naik, Nagesh and Palakshappa, M.G. (2012). Phytophthora foot rot (*Phytophthora capsici* Leonian.) of black pepper management through fungi toxicant and consortium in western Ghats of Karnataka. *Internat. J. Plant Protec.*, 5(1) : 157-159.

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## INTRODUCTION

Black pepper (*Piper nigrum* L.) high valued spice and widely used in Ayurvedic preparations has been under cultivation traditionally in arecanut and coconut mixed cropping systems since long time in Western Ghats of Karnataka. India exported more than half of the pepper produced here, that is 25,250 tonnes valued at Rs. 414.00 crores in 2008-09. Indian pepper fetches a premium price in major international markets because of its preference and intrinsic quality (Thomas, 2010).

In Karnataka, black pepper is cultivated in Coorg, Uttara Kannada, Dakshina Kannada, Shimoga, Chikmagalore and Hassan districts. Among the diseases of the crop, Phytophthora foot rot caused by *Phytophthora capsici* Leonian is a major and serious malady, causing huge economic loss and is the major constraints in its cultivation in Uttara Kannada Dist. of Karnataka under arecanut cropping system.

During monsoon and post monsoon, the crop was severely infected with the pathogen (*P. capsici*) at Sirsi, Uttara Kannada, Karnataka. This soil borne pathogen causes infection to leaves, stem, collar, root inflorescence, berries and results on mortality of the vines ranging from 34-65 per cent and resulting in huge monetary losses more than 46 per cent to farmers. Hence, an attempt was made to investigate the efficacy of potassium phosphonate and *Trichoderma harzianum* (MTCC-5179) and consortium of bacteria for control of the disease.

## MATERIALS AND METHODS

A field experiment was carried out by applying fungicides, bioagents and plant product like neem cake at Horticulture Research Station (University of Horticultural Sciences, Bagalkot, Karnataka) Sirsi taluka of Uttara Kannada district of Karnataka in central Western Ghats of India during 2008-09.

There were five treatments with six vines per treatment. There were four replications with RBD design. The fungicides, viz. Potassium phosphonate (0.3%), Bordeaux mixture (1%), Copper oxychloride (0.2%) were applied as spraying (@ 2 l<sup>-vine</sup>) and drenching (@ 3 l<sup>-vine</sup>) along with biocontrol agents *T. harzianum* (MTCC-5179) and consortium of bacteria @ 10<sup>8</sup> cfu/g (for growth, nematode and *Phytophthora* suppression –IISR-6 and IISR 859). The fungicides and bioagents were applied as spraying (@ 2 l<sup>-vine</sup>) and drenching (3 l<sup>-vine</sup>) along with bioagent *Trichoderma harzianum* (MTCC 5179) 50 g with one kg of neem cake as soil application during the first week of June and third week of August 2008 to the root zone. Unprotected vines served as control. Observations were made on per cent leaf infection, defoliation (PDI), death of vines (per cent), green berry yield (kg/vine) and projected yield (kg/vine).

## RESULTS AND DISCUSSION

Black pepper vines recorded least leaf infection (12.00 PDI), least yellowing (11.33 PDI), least defoliation (9.33 PDI), least death of vines (8 %) and highest green berry yield (1.03 kg<sup>-vine</sup> and 424.36 kg<sup>-ha</sup> projected yield) wherein vines were protected against *Phytophthora* foot rot of black pepper with application of Potassium phosphonate (@ 0.3 per cent) as spraying (@ 2 l<sup>-vine</sup>) and drenching (3 l<sup>-vine</sup>) along with bioagent *Trichoderma harzianum* (MTCC 5179) 50 g with one kg of neem cake as soil application during first week of June and third week August 2008 to the root zone. However, 1 per cent Bordeaux mixture as spraying (@ 2 l<sup>-vine</sup>) and Copper oxychloride (0.1 % a.i.) drenching twice during June and August 2008 was also significantly effective in checking the disease with less leaf infection (16.00 PDI), less yellowing (14.00 PDI), less defoliation (12.00 PDI), less death of vines (14 %) and more green berry yield (0.86 kg<sup>-vine</sup> and 354.32 kg<sup>-ha</sup> projected yield (Table 1).

In case of bioagents application i.e., Consortium of bacteria @ 10<sup>8</sup> cfu/g (for growth, nematode and *Phytophthora*

suppression –IISR-6 and IISR 859) as spraying (@ 2 l<sup>-vine</sup>) and drenching (@ 3 l<sup>-vine</sup>) and *Trichoderma harzianum* (MTCC 5179) 50 g with one kg of neem cake as soil application around the root zone of the vine twice (June and August) also significantly reduced the disease i.e., less leaf infection (22.00 PDI), less yellowing (20.00 PDI), less defoliation (14.67 PDI), less death of vines (18 %) and maximum green berry yield (0.75 kg<sup>-vine</sup>) and 287.12 kg<sup>-ha</sup> projected yield. This was followed by treating of vines alone with Consortium of bacteria @ 10<sup>8</sup> cfu/g (for growth, nematode and *Phytophthora* suppression –IISR-6 & IISR 859) as spraying (@ 2 l<sup>-vine</sup>) and drenching (@ 3 l<sup>-vine</sup>) twice which was found effective in reduction of leaf infection (24.00 PDI), less yellowing (21.33 PDI), less defoliation (17.33 PDI), less death of vines (20 %) and less green berry yield (0.60 kg<sup>-vine</sup>) and 243.45 kg<sup>-ha</sup> projected yield. The vines without any protection exhibited highest incidence of leaf infection (54.67 PDI), highest yellowing (36.67 PDI) and highest defoliation (25.33 PDI, highest death of vines (46 %) and minimum green berry yield (0.49 kg<sup>-vine</sup> and 200.23 kg<sup>-ha</sup> projected yield.

In the present investigation on management of *Phytophthora* foot rot of black pepper, with fungitoxicant, antagonistic and consortium of bacteria and their combinations, revealed a positive effect on significant decrease in disease intensity on treated vines. For the first time, in the present findings, based on observations with respect to leaf infection, foliar yellowing, defoliation and death of vines of the vines were found as crucial stages which obviously led to death of vines. The application of treatments twice in a year i.e., once in the month of June and second in August helped in checking the spread of the disease and may be due to reduction in inoculum level.

The vines which received the treatment combination of systemic fungicide and bioagents along with organic amendment neem cake, i.e. potassium phosphonate as spray and drench followed by bioagents *T. harzianum* (MTCC-5179), and neem cake reduced the disease significantly and brought

**Table 1 : Management of *Phytophthora* foot rot of black pepper in arecanut plantation**

Treatments	Leaf infection (PDI)	Yellowing (PDI)	Defoliation (PDI)	Death of vines (per cent)	Green berry yield (kg/vine)	Projected yield (kg/ha)
T <sub>1</sub> - Potassium phosphonate (0.3 %) + <i>T. harzianum</i> 50 g /vine with 1 kg of neem cake	12.00	11.33	9.33	8.00	1.03	424.36
T <sub>2</sub> - Bordeaux mixture (1%) +Copper oxychloride (0.1 % a.i.)	16.00	14.00	12.00	14.00	0.86	354.32
T <sub>3</sub> - Consortium of bacteria	24.00	21.33	17.33	20.00	0.60	243.45
T <sub>4</sub> - <i>T. harzianum</i> + Consortium of bacteria	22.00	20.00	14.67	18.00	0.75	287.12
T <sub>5</sub> - Control	54.67	36.67	25.33	46.00	0.49	200.23
S.E. ±	1.96	1.73	1.98	3.03	0.04	15.74
C.D. (P=0.05)	5.89	5.19	5.93	9.09	0.12	47.19

down the incidence to a lowest level. There may be synergistic effect of treatment combination on subsiding of disease incidence. The present investigation on integrated disease management is practical oriented and showed that the components of IDM as eco-friendly, economically feasible and compatible. It was revealed that the application of neem cake + phorate + Bordeaux mixture + Akomin (potassium phosphonate) was found effective in Phytophthora disease of pepper (Anonymous, 1996). The combined application of *Trichoderma viride* + Akomin (potassium phosphonate) brought down incidence of black pepper wilt (Anonymous, 1996). The present study on the results of integration of systemic fungicides and consortium of bacteria were also found similar to the findings of Hegde and Anahosur (1998), Jahagirdar *et al.* (2000) and Srinivasan *et al.* (2003).

Thus, the present findings identified application of potassium phosphonate (0.3 %) as spraying and drenching with soil application of *T. harzianum* (MTCC-5179), (50 g vine<sup>-1</sup>) along with neem cake (1 kg vine<sup>-1</sup>) as best treatment followed by bioagents application i.e., consortium of bacteria @ 10<sup>8</sup> cfu/g (for growth, nematode and Phytophthora suppression –IISR-6 & IISR 859) as spraying (@ 2 l<sup>-vine</sup>) and drenching (@ 3 l<sup>-vine</sup>) and *Trichoderma harzianum* (MTCC 5179) 50 g with one kg of neem cake as soil application around the root zone of the vine twice (June and August) also significantly reduced the disease with respect to less leaf infection, less yellowing,

less defoliation and less death of vines. The present findings could be adopted easily by the farmers to save the vines from the infectious Phytophthora foot rot of black pepper and could be cultivated profitably.

#### Acknowledgement:

The authors are grateful to Dr. M. Anandaraj, Director and Project Co ordinator (Spices), Indian Institute of Spices Research, Calicut, India for encouragement, technical guidance and financial support for conducting the experiment.

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