

## RESEARCH ARTICLE

# Integration of potassium phosphonate and bioagent against phytophthora foot rot (*Phytophthora capsici* Leonion) of black pepper (*Piper nigrum* L.) management in arecanut cropping system

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## ABSTRACT

Phytophthora foot rot is a serious disease in black pepper in Uttara Kannada district of Karnataka. Application of systemic fungicide, potassium phosphonate @ 0.3 per cent alone as spraying (3 l/vine) and drenching (5 l/vine) or integration of systemic fungicide, potassium phosphonate @ 0.3 per cent as spraying and drenching with bioagent, *Trichoderma viride* @ 50 g/vine along with 5 kg of farm yard manure to the basin of the black pepper vines during June and August were effective in reduction of disease incidence of Phytophthora foot rot of black pepper.

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## INTRODUCTION

Black pepper (*Piper nigrum* L.) king of spices, native to Western Ghats of India is being cultivated as an intercrop in arecanut based multistoried cropping system in Uttara Kannada district of Karnataka. The vines are trained on live standards of arecanut (*Areca catechu* L.) to fetch extra revenue to the planter without much additional cost of cultivation.

During 1978 sudden mortality of the vines due to rampant appearance of dreaded disease Phytophthora foot rot (*Phytophthora capsici* Leonian) was the major constraint for cultivation of the crop (Sastry, 1982, Dutta, 1984 and Sarma *et*

*al.*, 1994). Since, 1978 the disease appeared in epiphytotic form leading to elimination of the important popular local cultivars from plantations. The crop is cultivated in valley situation where the microclimate having very high humidity (80-100 per cent) with low temperature (18-28°C) and less sunshine. These conditions are very conducive for survival of the pathogen, its multiplication and spread. The pathogen is versatile in nature and infects all parts of the vine *i.e.* root, collar, stem, leaves, inflorescence and spike. It is a soil borne fungus and can survive in infected plant debris for long period. Single method is not effective in checking the disease. Hence, an integrated approach comprising phytosanitary measures, cultural, chemical, biological, resistant/tolerant cultivars are

necessary for effective management of the disease. The mechanisms involve like competition, mycoparasitism and production of volatile and non-volatile antibiotics (Chet, 1987). Suppressive effect of *Trichoderma* spp. on the soil borne root infecting fungal pathogens viz., *Phytophthora* spp., *Pythium* spp. *Fusarium* spp. and *Rhizactonia* spp. has been well established (Baker and Cook, 1974, Chet, 1987 and Papavizas, 1985). Potassium phosphonate, an antifungal compound systematically checked Phytophthora infection in black pepper (IISR, 1995). Sarma *et al.*, 1996 showed the compatibility of agro-chemicals with bioagents i.e., *Trichoderma* spp. *Gliocladium virens* and *Pseudomonas fluorescens* in checking the Phytophthora infection in black pepper. The paper presents the use of potassium phosphonate in combination with biocontrol agent i.e., *Trichoderma viride* for effective management of the disease under arecanut based cropping system.

## MATERIALS AND METHODS

The trial was laid out in six gardens in different locations around Sirsi, Uttara Kannada district of Karnataka. The soils were lateritic with 5.5 to 6.5 pH. range. The variety selected for the trial was Karimalligesara which was highly susceptible to the disease and was 8-10 years old. During the trial period, the average rainfall was 2601.43 mm with 112 rainy days distributed from June to December. There were five treatments with thirty vines in each treatment. The treatment consisted of fungicides viz., Bordeaux mixture (@ 1 per cent), Copper oxychloride (@ 0.3 per cent), Potassium phosphonate (Akomin @ 0.3 per cent) and bioagent, *T. viride* ( $10^7$  cfu @ 50 g per vine along with 5 kg of farm yard manure (FYM)). The vines were treated with fungicides as spray (@ 3 l/ vine) and drenched (@ 5 l/vine). The antagonistic organism, *T. viride* was applied to the basin of the vine without damaging the roots. The treatments were imposed twice during the season i.e., before onset of monsoon (June) and second round at 35 to 40 days after first rounds spray (August). The trial was conducted for four years i.e., from 2007 to 2010. The observation on the percentage of vine

infected was recorded and statistically analysed using standard statistical design.

## RESULTS AND DISCUSSION

The results (Table 1) of the study revealed that the disease incidence on the vines was least (6.42 per cent) in vines treated with potassium phosphonate (@ 0.3 per cent) as spray (@ 3 l/vine) and drench (@ 5 l/vine) in combination with bioagent *T. viride* ( $10^7$  cfu @ 50 g per vine along with 5 kg of FYM) twice in the season. This was followed by vines treated with application of potassium phosphonate as spray and drench (7.36 per cent). Application of biocontrol agent alone i.e., *T. viride* ( $10^7$  cfu @ 50 g per vine along with 5 kg of FYM) twice in the season also reduced the disease incidence (14.72 per cent). But the efficacy of the biocontrol agent was less when compared to the vine treated with Bordeaux mixture (@ 1 per cent) as spray (@ 3 l/vine and copper oxychloride as drench (@ 5 l/vine) twice in the season (10.42 per cent). The severity of the disease in the vines was maximum in untreated check (31.92).

The results were in conformity with the findings of Sarma *et al.* (1996) where they reported that the compatibility of agro-chemical potassium phosphonate with bioagent *Trichoderma* spp. in checking the Phytophthora infection in black pepper. Usman *et al.* (1997) revealed that volatile and non-volatile metabolites produced by the *Trichoderma* spp. suppressed the growth of the *Phytophthora* spp. They further stated that *Trichoderma* spp. interacted with the hyphae of the pathogen by production of abnormal granules, cytoplasmic vacuolation and coagulation. This resulted in reduction of the disease by adversely affecting the survivability of the pathogen. Rajan and Sarma (1997) reported the varying degrees of inhibition on growth of *Phytophthora capsici* by biocontrol agent, *Trichoderma* spp. and agro-chemical potassium phosphonate on checking the root rot in black pepper. The present finding showed that Phytophthora foot rot of black pepper could be managed by integration of agro-chemical potassium phosphonate and bioagent *Trichoderma viride* with no

**Table 1: Management of Phytophthora foot rot in black pepper under arecanut cropping system**

Treatments	Per cent disease incidence				Pooled
	2007	2008	2009	2010	
Control	33.88	17.77	34.44	41.67	31.92
Bordeaux mixture (@ 1 %) spraying and Copperoxy chloride (@ 0.3 %) drenching twice	8.88	6.11	7.22	19.45	10.42
Potassium phosphonate(@ 0.3 %) spraying and drenching twice	6.66	4.44	6.67	11.67	7.36
Bioagent ( <i>Trichoderma viride</i> ) @ 50 g/vine to the basin of the vine along with 5 kg of FYM/vine	20.55	7.20	10.56	20.56	14.72
Potassium phosphonate (0.3 %) spray twice and bioagent ( <i>Trichoderma viride</i> ) @ 50 g/ vine to the basin of the vine along with 5 kg of FYM	5.29	5.64	5.97	8.76	6.42
S.E. ±	0.86	1.28	1.19	1.73	1.27
C.D. at 5 %	2.52	3.76	3.50	5.10	3.72

residual effect in the produce and at the same time improved the health of the soil and plant.

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