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Compatibility of potassium phosphonate (Akomin-40) with different species of *Trichoderma* and *Gliocladium virens*

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Abstract

Biocontrol agents viz., *Trichoderma* spp and *Gliocladium virens* showed varying degrees of inhibition on growth of *Phytophthora capsici*, the foot rot pathogen of black pepper. Potassium phosphonate (Akomin), an antifungal compound has been found to check root rot in black pepper. In integrated disease management programme, compatibility of biocontrol agents with the fungicide is crucial. In the present study sensitivity of 8 species of *Trichoderma* and one species of *Gliocladium* to potassium phosphonate was tested. No significant effect was noticed even at concentration as high as 1200 ppm of potassium posphonate, while in *Trichoderma aureoviride* and in *Trichoderma pseudokoningii*, increased sporulation was noticed with potassium phosphonate compared to control. Of the isolates tested *Gliocladium virens*, *Trichoderma harzianum* and *Trichoderma hamatum* were found effective in the inhibition of the pathogen. These isolates showed different degrees of protection against root rot. The present results clearly established the compatibility of biocontrol agents with potassium phosphonate, which forms a component in the integrated disease management programme.

Key words: *Gliocladium virens*, *Phytophthora capsici*, potassium phosphonate, *Trichoderma*

Introduction

Phytophthora foot rot is the major production constraint in black pepper and an integrated approach involving cultural, chemical and biological control methods coupled with host resistance is the strategy adopted for disease management (Sarma, Anandaraj & Rajan 1994). The efficacy of systemic fungicides viz., Metalaxyl, Fosetyl-Al has been reported (Ramachandran & Sarma 1991). The efficacy of potassium phosphonate (Akomin), an antifungal compound showing systemic effect in

checking *Phytophthora* infection in black pepper and also of biocontrol agents viz., *Trichoderma* spp. and *Gliocladium virens* has been reported (IISR 1995). The compatibility of agrochemicals with biocontrol agents viz., *Trichoderma* spp, *Gliocladium virens* and *Pseudomonas fluorescens* used in checking *Phytophthora* infection in black pepper has been highlighted (Sarma *et al.* 1996). The present study was undertaken to test the sensitivity of *Trichoderma* spp. and *Gliocladium virens* to potassium phosphonate which is now being used extensively in the management of *Phytophthora* caused plant diseases.

Materials and methods

Eight *Trichoderma* species viz., *T.aureo viride*, *T.hamatum*, *T.harzianum*, *T.koningii*, *T.longibracheatum*, *T.polysporum*, *T.pseudokoningii*, *T.viride* and *Gliocladium virens* from culture collection of Indian Institute of Spices Research were used in the present study. Stock cultures of these antagonistic fungi were maintained on PDA slants, stored in BOD incubator at 20°C for further studies.

Potassium phosphonate formulation supplied by M/S Rallis Agrochemicals, Bangalore, India was used for the studies. Potassium phosphonate formulation was passed through a sterile G5 filter for sterilisation and stored in refrigerator for further studies. For all the studies, 3 concentrations of the chemical viz; 400, 800 and 1200 ppm were used. For each treatment four replications were maintained and experiments were conducted at room temperature.

Growth of antagonistic fungi

To study the compatibility of potassium phosphonate with different biocontrol agents, 3 concentrations of the chemical (400,800 and 1200 ppm) were incorporated in sterile PDA medium at the time of pouring into the petri plates. Culture discs (0.5cm) of the test isolates were taken from actively growing cultures (48 h old) and plated. Culture raised on PDA without potassium phosphonate served as control for each isolate. Growth of each isolate was recorded at 24 h interval upto 72 h.

Sporulation of antagonistic fungi

To study the effect of potassium phosphonate on sporulation, cultures of different biocontrol agents were raised on PDA incorporating the different concentrations of potassium phosphonate. After 96 h, 10 discs (0.5cm.) per plate were randomly taken in 80ml of sterile double distilled water in 250ml beakers and agitated thoroughly with the help of magnetic stirrer and the contents were made upto 90ml with sterile double distilled water. Spores in each treatment were counted with the help of hoemocytometer.

Data were analysed by using statistical software MSTATC. Factorial analysis with the concentrations (3) as one factor and species (9) as second factor with four replications was done.

Results and discussion

Growth of different biocontrol agents differed considerably during the test period. *T.aureoviride*, *T.viride* and *Gliocladium virens* attained maximum radial growth within 24 h. But after 48 h, *T.pseudokoningii*, *T.viride*, *T.aureoviride*, *T.harzianum* and *G.virens* attained maximum radial growth (45.00mm) and the least growth was recorded in *T.hamatum* (32.67 mm). After

72 h, all species of *Trichoderma* and *G.virens* attained maximum growth in all control plates.

In plates treated with 400ppm of potassium phosphonate, all the species of *Trichoderma* and *G.virens* showed significant difference in the growth. After 24 h *T.harzianum* attained maximum growth (30.25mm) compared to all other isolates tested and significantly least growth was recorded in *T.polysporum* (12.75mm). The growth of *T.hamatum* and *T.aureoviride* was at par (Table 1).

Table 1. Effect of potassium phosphonate on growth of different species of *Trichoderma* and *Gliocladium virens*

Conc.	Radial growth in mm (after 24 h)								
	T.pse	*T.koni*	*T. Poly*	*T.long*	*T.ham*	*T.harz*	*T.viri*	*T.aure*	*G.vir*
400ppm	19.75	17.75	12.75	19.00	16.00	30.25	23.00	16.00	20.25
800ppm	21.50	17.00	13.75	16.50	14.00	18.25	23.25	18.25	17.25
1200pp	21.00	18.00	13.50	14.50	11.00	17.50	19.75	20.75	17.00
Control	22.75	16.25	17.50	21.75	15.75	22.00	24.00	24.75	24.00
CD ($p<0.05$)=1.244									
	(after 48 h)								
400ppm	45.00	35.50	31.45	33.88	30.42	40.63	43.63	40.63	42.08
800ppm	43.75	32.08	31.36	30.92	27.55	35.88	38.92	40.75	30.33
1200pp	45.00	33.08	28.83	26.67	22.50	32.15	35.83	34.92	30.83
Control	45.00	34.15	37.58	39.90	32.67	45.00	45.00	45.00	45.00
CD ($p<0.05$)=1.714									
	(after 72 h)								
400ppm	45.00	35.50	31.45	33.88	30.42	40.63	43.63	40.63	42.08
400ppm	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00
800ppm	45.00	45.00	45.00	45.00	42.00	45.00	45.00	45.00	45.00
1200pp	45.00	45.00	45.00	45.00	24.00	45.00	45.00	45.00	45.00
Control	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00
CD ($p<0.05$)= 0.7563									

After 48 h *T.pseudokoningii*, *T.harzianum*, *T.viride*, *T.aureoviride* and *G.virens* attained maximum radial growth (45.00mm) and considerably least growth was recorded in *T.hamatum* both in treated and control plates (Table 1). In plates treated with 800 ppm of potassium phosphonate, *T.viride* attained maximum radial growth (23.25mm). After 48 h *T. pseudokoningii* attained maximum growth (43.74mm) followed by *T.aureoviride* (40.75mm) and least was in *T.hamatum* (27.55mm).

Cultures treated with 1200ppm of po-

tassium phosphonate showed significant differences in growth. *T.pseudokoningii* attained maximum growth (21.10mm), within 24 h compared to all other isolates, followed by *T.aureoviride* (20.75mm) and least was in *T.hamatum* (11.0 mm) and *T.polysporum* (13.50mm).

After 48h, *T.pseudokoningii* attained maximum growth (45.00 mm) followed by *T.viride* and least growth was observed in *T.hamatum* (22.50mm).

After 72 h, all the species of *Trichoderma* and *G.virens* attained maximum radial growth (45.00 mm) in all the treated and untreated plates except in *T.hamatum* (Table 1). *T.hamatum* attained 24.00 mm (46.44% reduction) in 1200 ppm treated plates. Not much difference was observed in growth of biocontrol agents at different concentrations of the chemical.

From the sporulation study, highest spore count was observed in *T.harziaum* in treated and nontreated plates, followed by *Gliocladium virens* and the least spore count was noticed in *T.longibracheatum* (Table 2). Even after 96 h. *T.viride* did not sporulate even in control plates. Out of eight species of *Trichoderma* and *Gliocladium virens* tested, *T.pseudokoningii* recorded highest spore load in 400 ppm treated plates (342503 spores per ml).

Table 2. Effect of Potassium phosphonate (Akomin) on sporulation of different species of *Trichoderma* and *Gliocladium virens*

Conc.	Spore count per ml. after 96 h								
	T.pse	*T.koni*	*T. Poly*	*T.long*	*T.ham*	*T.harz*	*T.viri*	*T.aure*	*G.vir*
Con	10130	12500	62480	2522	3123	250616	0.0	17880	87480
400.ppm	342503	1872	00.00	3540	00.00	13750	0.0	8750	10620
800.ppm	38120	1252	00.00	3748	00.00	75.03	0.0	15070	6251
1200 ppm	265033	1248	00.00	2510	00.00	10040	0.0	13750	4372

CD)P<0.05)=30.32

Spore count/ml.after 168 h

	T.polysporum	T.hamatum	T.viride
Control	63030	31250	00.00
400ppm	18750(7025%)*	8248(73.60%)*	00.00
800 ppm	13750(78.15%)*	1248(96.00%)*	00.00
1200ppm	1248 (98.01%)*	1248(96.00%)*	00.00

*Reduction in spore count

CD (p<0.05) = 12.30

In *T.polysporum*, *T.hamatum* the sporulation was not observed in treated plates and in non treated plates of *T.viride*. *T.viride* did not sporulate even after 196 h. In *T.pseudokoningii*, increment of spore load was observed in an 1200 ppm treated plates.

Potassium phosphonate has no negative effect on the host and plant products (Johri & Chourasia 1995) and it was also reported that it enhances the

overall growth of the plants (Merwe & Dev Van Der 1993) and yield in avocado (Pegg *et al.* 1987). Potassium phosphonate is found very effective against many phytopathogenic fungi. The mode of its action on pathogens was described (Smillie, Grant & Guest 1989; Guest & Bompeix 1990).

Potassium phosphonate was found compatible with *Enterobacter aerogens* (Utkhede & Smith 1993) and also reported that it has no negative effect on other soil microbes in pepper corn and avocado field (Wongwathanarat & Sivasithamparam 1991). Recent studies showed that, this fungicide is compatible with *Trichoderma harzianum* (Sharma & Ashok Mishra 1995).

Potassium phosphonate (Akomin) is widely used to control the foot rot disease of black pepper. Field trials, clearly showed that the biocontrol agents like *Gliocladium virens*, *T.harizianum* and *T.hamatum* are found very effective in disease suppression. From this compatibility study it is clear that this chemical can be used along with the biocontrol agents to control the disease in field.

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