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Research Note

Compatibility of *Pseudomonas fluorescens* with agricultural chemicals

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ABSTRACT: The compatibility of *Pseudomonas fluorescens* with 15 fungicides, 9 insecticides and 10 weedicides was tested under laboratory condition. All insecticides, herbicides and 12 fungicides except saaf, kocide (copper hydroxide) and zineb were found to be compatible with *P. fluorescens*. The study indicated that most of the fungicides, insecticides and weedicides can be mixed with *P. fluorescens* for use in agriculture.

KEY WORDS: *Pseudomonas fluorescens*, insecticides, weedicides, fungicides, compatibility

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Kuttanad, the rice bowl of Kerala, is an unique agricultural tract with the paddy fields lying 0.6 to 2.0 m below the mean sea level. Rice production in this tract has been laborious and expensive. Kuttanad being endemic to major pests and diseases of rice, is recognized as a “hot spot” for screening and evaluation of a number of commercial pesticides. Integrated management of pests, diseases and weeds has been prevalent in the area for over sixty years. *Pseudomonas* spp. are effective root colonizers and biocontrol agents by producing antifungal metabolites including antibiotics, hydrogen cyanide and siderophores (O’Sullivan and O’Gara, 1992). In recent years, emphasis has been laid on the combined use of biocontrol agents along with chemical pesticides for effectively managing the pests, diseases and weeds. In the present study, the *in vitro* compatibility of *P. fluorescens* (PF 43) with the recommended dosage major groups of insecticides, fungicides and herbicides was explored.

A study on compatibility of effective strain of *P. fluorescens* (PF 43) with fungicides, insecticides and herbicides were conducted during 2011 under laboratory conditions using poison food technique. The doses of each pesticide was fixed as per recommendation of package of practices, Kerala Agricultural University. The standard recommended doses (g/ml lit^{-1}) of 15 fungicides, 9 insecticides and 10 weedicides were used for the compatibility study of *P. fluorescens* with three replications. The chemicals were mixed with melted King’s B medium separately and poured in sterilized petri dishes. Forty eight hour old *P. fluorescens* culture was streaked in the centre of each plate and kept under room temperature. A control without chemicals was maintained for comparison. Observations were recorded after 48 hours of incubation by measuring the growth of *P. fluorescens* in the treated plates.

Results of the fungicide compatibility study (Table 1) showed that *P. fluorescens* PF 43 culture was compatible with 12 fungicides at the commercially recommended doses, except three fungicides namely carbendazim, copper hydrochloride and zineb where the growth of *Pseudomonas* was completely arrested (Plate 1). Previous studies by Leha and Venkataraman (2001) also have shown that carbendazim was compatible with *P. fluorescens*. Kishore *et al.* (2005) found that a combination of *P. aeruginosa* GSE 18 and chlorothalonil (500 ìg ml^{-1}) reduced the severity of late leaf spot in groundnut comparable to chlorothalonil (2000 ìg ml^{-1}) alone.

All the 9 insecticides tested were compatible with *P. fluorescens* under laboratory condition (Table 2). Mathew (2003) studied the compatibility of *P. fluorescens* with nine pesticides and found that mancozeb,

Table 1. Compatibility of *Pseudomonas fluorescens* with fungicides under *in vitro* condition

Sl. No.	Fungicide	Chemical name	Dose (g/ml lit^{-1})	Growth at 48 hr after incubation (mm)
1	Contaf	Hexaconazole 5 SC	2.0 ml	9.7
2	Saaf	Carbendazim 12% + Mancozeb 63% WP	1.5 g	0
3	Tilt	Propiconazole 25 EC	1.0 ml	24.0
4	Bavistin	Carbendazim 50 WP	1.0 g	18.7
5	Nativo	Tebuconazole (50%) + Trifloxystrobin (25%) 75 WG	0.4 g	20.3
6	RIL-068/F1	Kresoxim methyl 40% + Hexaconazole 8% WG	1.0 g	21.3
7	Ergon	Kresoxim methyl 44.3 SC	1.0 ml	18.7
8	Kocide 101	Copper hydroxide 77 WP	2.0 g	0
9	Filia	Tricyclozole (40%) + Propiconazole (12.5%) 52.5 SE	2.0 ml	18.3
10	Folicure	Tebuconazole 25.9 EC	0.1 ml	20.0
11	Neem Azal	Azadirachtin 10000 ppm	3.0 ml	20.7
12	Indofil M-45	Mancozeb 75 WP	4.0 g	6.0
13	Indofil Z-78	Zineb 75 WP	4.0 g	0
14	Kitazin	Iprobenfos 48 EC	1.0 ml	20.7
15	Baan	Tricyclozole 75 WP	1.0 g	13.7
16	Control			31.5

0 – Incompatible; <10 mm; Compatible; <20 mm; Good compatible; >20 mm; Highly compatible

Table 2. Compatibility of *Pseudomonas fluorescens* with insecticides under *in vitro* condition

Sl. No.	Insecticide	Chemical name	Dose (g/ml lit^{-1})	Growth at 48 hr after incubation (mm)
1	Rogar	Dimethoate 30 EC	3.0 ml	13.7
2	Avaunt	Indoxacarb 14.5 SC	0.4 ml	19.3
3	Tracer	Spinosad 45 EC	0.25 ml	31.0
4	Ekalux	Quinalphos 25 EC	2.5 ml	17.3
5	Fame	Flubendiamide 39.35 SP	0.2 ml	15.0
6	Spark	Deltamethrin 1% + Triazophos 35% EC	2.5 ml	22.3
7	Takumi	Flubendiamide 20 WG	0.35 g	20.7
8	Sevin	Carbaryl 50% WDP	3.0 g	19.7
9	Azataf	Acephate 75 SP	1.6 g	21.3
10	Control			21.0

0 – Incompatible; <10 mm; Compatible; <20 mm; Good compatible; >20 mm; Highly compatible

Table 3. Compatibility of *Pseudomonas fluorescens* with herbicides under in vitro condition

Sl. No.	Weedicide	Chemical name	Dose (g/ml lit^{-1})	Growth at 48 hr after incubation (mm)
1	Fernoxone	2,4 D Sodium salt 80 WP	3.125 g	20.7
2	Almix	Metsulfuron methyl 10% + Chlorimuron ethyl 10% WP	0.08 g	24.0
3	Clincher	Cyhalofop-butyl 10 EC	3.2 ml	23.7
4	Saathi	Pyrazosulfuron ethyl 10 WP	0.7 g	26.7
5	Sofit	Pretilachlor 30.7% + Safener Fenclorim 7.67% EC	3.71 ml	25.7
6	Refit	Pretilachlor 50 EC	3.75 ml	28.0
7	GF-443	Penoxsulam 24 SP	0.3 ml	28.7
8	Nominee gold	Pispyribac sodium 10 SC	1.0 ml	24.3
9	Taarak	Pispyribac sodium 10 SC	1.0 ml	33.7
10	Adora	Pispyribac sodium 10 SC	1.0 ml	19.0
11	Control			26.0

0 – Incompatible; <10 mm; Compatible; <20 mm; Good compatible; >20 mm; Highly compatible

carbendazim, chlorpyriphos and imidacloprid were highly compatible with *P. fluorescens* strain P11 at the recommended dose for field use. Another study on the compatibility of diafenthiuron with antagonistic microorganisms of plant pathogens *viz., Trichoderma viride* and *Pseudomonas fluorescens* revealed that diafenthiuron had some inhibitory effect on the mycelial growth of *T. viride*. Diafenthiuron did not affect the growth of *P. fluorescens* and thus can be used simultaneously for the control of insect pests and seed and soil borne diseases of cardamom.

All the 10 weedicides tested were highly compatible with *P. fluorescens* (PF 43) in the present study. Beethi and Pillai (2008) reported that compatibility of *P. fluorescens* was questionable with pretilachlor while, it showed compatibility with 2,4 D sodium salt. In the present study pretilachlor 50 EC showed compatibility with *P. fluorescens* (PF 43).

A combination of biocontrol agents with chemicals will have an additive effect and results in enhanced disease control compared to their individual application (Guetsky *et al.,* 2002). This is necessary to find out the possibility of its utilization in integrated disease management. The present investigation indicated that most of fungicides, insecticides and herbicides tested were compatible with *P. fluorescens* and it could be recommended to the farmers. In rice cultivation, 20% of the cost of cultivation is due to plant protection activities, mainly towards cost of labour for spraying. Scarcity in the availability of labourers in rice farming has forced farmers to shift from manual weeding to herbicidal application for the management of weeds. Similarly, heavy infestation of insect pests in the hot humid tropics of Kerala warrants insecticidal applications for their control. The finding that *P. fluorescens* is compatible with the commonly used weedicides, insecticides and fungicides will enable its enhanced use in rice farming with better results with enhanced environmental safety.

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Brainstorming Session
on
Roadmap for Entomopathogenic Nematode Research and Utilization in IPM

The Society for Biocontrol Advancement (SBA) and National Bureau of Agriculturally Important Insects, Bengaluru, jointly organized one-day brainstorming session on Roadmap for Entomopathogenic Nematode Research and Application/Utilization in IPM on 20th April 2012 at NBAII, Bengaluru. The aim was to understand, evaluate and re-orient the current research on EPN in India by identifying priority areas based on the needs of stakeholders, consolidate a working group and co-ordinate the research outcome for effective utilization. The meeting was attended by more than 60 scientists specializing in Entomology, Nematology, Microbiology, and Biotechnology.

The participants included eminent scientists like Dr. T. P. Rajendran (ADG-PP, ICAR), Dr. N. K. Krishna Kumar (Director, NBAII), Dr. S. S. Hussaini (Retired Principal Scientist, NBAII) and scientists from different ICAR institutes, Central Government Boards, State Agricultural Universities and private entrepreneurs. The thrust areas discussed were a) Biodiversity of EPN and bacterial feeding nematode fauna; b) Molecular identification; c) Genomics of EPN, functional proteomics; d) National repository for EPN germplasm and e) Production, formulation and application technologies of EPN in IPM .

Several subgroups were formed to specifically dwell upon the various issues and draft recommendations were finalised for inclusion in EFC under the 12th Plan of NBAII, a Operational Research Project proposal on the lines of ICAR's AMAAS/Phytonet network projects.

The following recommendations emerged from the meeting:

1. There is a strong need to have an Operational Research Project (ORP) to address priority areas of research on EPN with a nodal base at National Bureau of Agriculturally Important Insects (NBAII), Bengaluru.
2. A National Repository for EPN germplasm at NBAII, Bengaluru and IARI, New Delhi to be established with appropriate facilities for identification services, molecular characterization etc. along with IPR guidelines.
3. Specific modalities need to be worked out at NBAII for developing industry-institute partnerships, collaboration and linkages for commercial scale production, quality formulations and delivery systems of EPN.
4. Training and HRD services need to be strengthened at NBAII and IARI on cataloguing the EPN diversity, taxonomy, scale up production and utilization of EPN through the ORP.
5. An external evaluation committee may be constituted by the ICAR.