Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
www.entomoljournal.com
JEZS 2020; 8(5): 1499-1502

Received: 12-06-2020
Accepted: 10-08-2020

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New report on antifungal activities of commercial insecticides against ginger soft rot and tomato early blight pathogens

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Abstract
Agriculture and horticultural crops are every year severely affected with insect pests and diseases. Hence, insecticides and fungicides have predominant role in crop protection sector of agriculture and horticulture. Hence screening of commercial insecticides for antifungal activity is very much essential to reduce cost of crop protection. Were evaluated ten commercial insecticides against fungal pathogens by following poison food technique. Among evaluated insecticides, Emamectin benzoate 5 SG (Proclaim) showed statistically superior antifungal activity with 100.00 per cent mycelial inhibition of *Pythium aphanidermatum* at 0.02% concentration followed by Profenofos 50 EC (90.97%) at 0.2% concentration. Among ten commercial insecticides were evaluated against *Alternaria solani,* Emamectin benzoate 5 SG (Proclaim) showed excellent antifungal activity with 100.00 per cent mycelial inhibition of *A. solani* at 0.02% concentration followed by Profenofos 50 EC (85.09%) and Chloropyriphos 20 EC (83.52%) at 0.2% concentration. The antibiotic streptocycline showed 53.33% and 63.52% mycelial inhibition of *P. aphanidermatum* and *A. solani* respectively at 0.05% concentration.

Keywords: *Alternaria solani*, antifungal activity, insecticides, *Pythium aphanidermatum*

1. Introduction

Insecticides are kind of pesticides which are known to kill insect pest of agricultural crops. Including insecticidal properties, some insecticides also has antifungal or plant growth promotion activities. It is estimated that in India, crop loss due to pests ranges from 10-30 percent a year, out of which 26% is due to the insect pests [1]. The changing agroclimatic conditions contributed largely to the infestation of various insect pests in different parts of the country. Most of the insecticides commonly used are technically classified as neurotoxins (i.e., the target site within the target organism is some aspect of the nervous system). Only a few of the commonly used insecticides, such as the insect growth regulators (juvenile hormone analogs and chitin synthesis inhibitors) and a few miscellaneous active ingredients (borates, energy inhibitors, and dehydrating dusts), do not target the nervous system.

Soft rot is the most important disease of ginger in Karnataka. The disease is caused by *Pythium aphanidermatum* (Edson) Fitzp. There are15 *Pythium* species have been implicated as pathogens of the soft rot disease all over the world. The pathogen infects roots, collar and succulent parts of the rhizome. It is the most destructive disease of ginger, which can reduce the production by 50 to 90% [2]. Among the fungal diseases of tomato, early blight caused by *Alternaria solani* is one of the most important and frequent occurring disease of the crop nation and worldwide [3]. *Alternaria solani* infect all the aboveground parts of the plant at all stages of growth and development. The plants are more susceptible to infection by the pathogen during fruiting period. The early blight was the most catastrophic diseases incurring loss under field and post harvest stages causing 50 to 86 percent reduction in fruit yield and complete crop failure can occur when the disease is most severe [4, 5]. Hence, present investigation was carried out to find out antifungal properties of some new commercial insecticides and antibiotic against fungal pathogens of ginger and tomato under *in vitro* condition.

2. Material and Methods

2.1 Isolation and characterization of plant pathogens

Commercial insecticides were evaluated against major plant pathogens *viz., Pythium aphanidermatum* and *Alternaria solani.*

These plant pathogens were collected from infected tissues which showed typical characteristic symptoms and isolated by standard procedures. Fungal plant pathogens *P. aphanidermatum* and *A. solani* were isolated from rhizome of ginger and fruits of tomato on potato dextrose agar (PDA) by standard tissue isolation method, purification of culture was done by hyphal tip method. Further, isolated pathogens were morphologically characterized.

2.2 Pathogenicity of fungal pathogens

For *P. aphanidermatum*, the pathogenicity was proved under glasshouse condition using Sirsi local variety of ginger. Giant culture of *P. aphanidermatum* was multiplied on sorghum grains and inoculated to 45 days old ginger plants. Pots were maintained at 50 per cent moisture holding capacity. Observation was made every alternative day for development of wilt symptoms. Those plants which showed wilt symptoms were carefully uprooted and pathogen was re-isolated and compared with original culture.

Tomato seedlings (PKM-1) were grown in earthen pots filled with sterilized soil. Thirty days old plants were sprayed with sterile distilled water before inoculation. Then plants were covered with polythene bag for 24 hr. Spore and mycelial suspension of *Alternaria solani* was prepared in sterile water. The spores suspension was sprayed and swabbed with moist cotton on to leaves. Such inoculated plants were again covered with polythene bag. The inner walls were lined with the moist absorbent cotton to ensure high humid conditions. After 48 hr of incubation polythene bag was removed and the plants were kept in glass house. Control was maintained by spraying the plants with only sterile distilled water. Observations were made for symptoms development periodically. Re-isolations were made from infected plants and the cultures thus obtained were compared with original cultures to confirm the identity and pathogenicity.

2.3 Evaluation of commercial insecticides against fungal pathogens

Ten commercial available insecticides (Table 1) were evaluated *in vitro* against *P. aphanidermatum* and *A. solani* by following poisoned food technique. Breifly, 20 ml of Potato Dextrose Agar (PDA) medium was initially mixed with insecticides at different concentration and was poured into Petri dishes (90 mm diameter). Positive check was maintained with addition of standard fungicide and untreated check was maintained as PDA alone. After solidification of media, 10 mm discs of above fungal pathogens were placed at the centre of the plates separately. Each set of experiments was replicated three times and plates were incubated at 28 ± 1 °C. Per cent inhibition of growth was calculated using the formula [6].

$$I = \frac{C - T}{C} \times 100$$

I = Per cent inhibition
C = Radial growth of fungus in control (mm)
T = Radial growth of fungus in treatment (mm)

Table 1: List of insecticides evaluated against fungal plant pathogens

Insecticides (Chemical name)	a.i.	Trade name	Dosage (per Litre)	Manufacturer	Recommended for (as in label)
Azardirachtin	0.03 EC	Nimbecidine	5 ml/L	T stanes and Company	2.5-3 litres/ha
Novaluron + Emamectin benzoate	5.25+0.9 SC	Barazide	2 ml/L	ADAMA	300 ml/acre
Cypermethrin	10 EC	Superkiller-10	2 ml/L	Dhanuka	25-300 ml/acre
Cholopyriphos	20 EC	Dhanvan - 20	2 ml/L	Dhanuka	750-1000ml/acre
Profenofos	50 EC	Curacron	2 ml/L	Syngenta	400 ml/acre
lambda Cyhalothrin	5 EC	Karate	0.5 ml/L	Syngenta	0.4 – 0.5kg / Ha
Spinetoram	11.7 SC	Delegate	0.5 ml/L	Corteva	1Kg/acre
Flubendiamide	39.35 SC	Fame 480	0.5 ml/L	Bayer	100 ml/acre
Chlorantraniliprole	18.5 SC	Coragen	0.2 ml/L	Dupont	60 ml/acre
Emamectin benzoate	5 SG	Proclaim	0.2 ml/L	Syngenta	100 ml/acre

2.4 Statistical analysis

Statistical analysis of the data was carried out as per the procedures given by Panse and Sukhatme [7]. Actual data in percentage were converted to arc sign values and $\sqrt{X} + 1$, before analysis according to the table given by Snedecor and Cochran [8].

3. Results and Discussion

Plant pathogens and insects pests are the major threat for production of agricultural and horticultural crops. Insecticides and fungicides are generally recommended to control insect pests and fungal plant pathogens respectively. These pesticides are used separately to control pests which results in higher cost of crop protection and more pesticide residue problems. A single pesticide with dual action is highly encouraged but research studies in these aspects are completely ignored. In spite of searching new molecules, exploitation of existing pesticides is economic and meaningful approach. The present investigation deals with revealing the antifungal properties of commercial insecticides.

Ten commercial insecticides were evaluated against *Pythium aphanidermatum.* Among them, Emamectin benzoate 5 SG (Proclaim) showed statistically superior antifungal activity with 100.00 per cent mycelial inhibition at 0.02% concentration followed by Profenofos 50 EC (90.97%) at 0.2% concentration. The three insecticides showed more than 60.00 per cent mycelial inhibitions are Chloropyriphos 20 EC (67.44%), Novaluron 5.25 + Emamectin benzoate 0.9 SC (62.74%) and Azardirachtin 0.03 EC (61.56%) at 0.2%, 0.2% and 0.5% concentrations respectively. The five insecticides showed more than 50.00 per cent mycelial inhibitions are Lambda Cyhalothrin 5 EC (59.21%), Spinetoram 11.7 SC (57.64%), Chlorantraniliprole 18.5 SC (54.11%), Flubendiamide 39.35 SC (52.94%) and Cypermethrin 10 EC (52.94%) at 0.05%, 0.05%, 0.02%, 0.05% and 0.2% concentrations respectively. The antibiotic streptocycline showed 53.33 per cent mycelial inhibition of *Pythium aphanidermatum* at 0.05% concentration (Table 2 and Fig. 1).

Ten commercial insecticides were evaluated against *Alternaria solani.* Among them, Emamectin benzoate 5 SG

(Proclaim) showed superior antifungal activity with 100.00 per cent mycelial inhibition at 0.02% concentration followed by Profenofos 50 EC (85.09%) and Chloropyriphos 20 EC (83.52%) at 0.2% concentration. Novaluron 5.25 + Emamectin benzoate 0.9 SC showed 74.50 per cent mycelial inhibition at 0.2% concentration. The five insecticides showed more than 60.00 per cent of mycelial inhibitions are Azardirachtin 0.03 EC (67.44%), Spinetoram 11.7 SC (67.44%), Cypermethrin 10 EC (63.91%), Chlorantraniliprole 18.5 SC (60.39%) and Lambda Cyhalothrin 5 EC (60.00%) at 0.5%, 0.05%, 0.2%, 0.02% and 0.05% per cent concentrations respectively. The antibiotic streptocycline showed 63.52 per cent mycelial inhibition of *A. solani* at 0.05% concentration (Table 2 and Fig. 2). Findings on antifungal activity of Azardirachtin are agreement with Bhonde *et al*. [9], who screened the different neem commercial formulation against major plant pathogen. Among the different formulations evaluated, Achook (0.15% EC) was found to be more active in terms of Minimum Inhibition Concentration (MIC) value followed by Bioneem, Neemark and Nimbecidine against *Fusarium oxysporum*, *Alternaria solani*, *Curvularia lunata*, *Helminthosporium* sp. and *Sclerotium rolfsii*. Dinesh *et al* [10] had evaluated three insecticides *viz***.** imidacloprid, fipronil and chlorpyriphos aginst *Sclerotium rolfsii* and found that chlorpyriphos had shown 100 percent inhibition at minimum concentration (0.125%) evaluated. Meena *et al.* [11] reported that, spraying of Nimbecidine (azadirachtin) provided good control of Alternaria blight disease. Some of plant based insecticides are evaluating against plant pathogens but there is lack of screening of commercial insecticides against plant pathogen. It is the first report on antifungal activities of commercial insecticides. Through adaptation on single molecules with dual benefits, the cost of crop protection can be reduced and helpful in reduction of environmental pollution.

Table 2: Antifungal efficacy of commercial insecticides and antibiotic

Insecticide	Trade name	Concentrations	Per cent Mycelial Inhibition	
			Pythium aphanidermatum	***Alternaria solani***
Azardirachtin 0.03 EC	Nimbecidine	0.5 %	61.56 (51.67)	67.44 (55.19)
Novaluron 5.25 + Emamectin benzoate 0.9 SC	Barazide	0.2 %	62.74 (52.36)	74.50 (59.65)
Cypermethrin 10 EC	Superkiller-10	0.2 %	52.94 (46.67)	63.91 (53.06)
Chloropyriphos 20 EC	Dhanvan - 20	0.2 %	67.44 (55.19)	83.52 (66.03)
Profenofos 50 EC	Curacron	0.2 %	90.97 (72.49)	85.09 (67.26)
Lambda Cyhalothrin 5 EC	Karate	0.05 %	59.21 (50.29)	60.00 (50.75)
Spinetoram 11.7 SC	Delegate	0.05 %	57.64 (49.38)	67.44 (55.19)
Flubendiamide 39.35 SC	Fame 480	0.05 %	52.94 (46.67)	55.68 (48.24)
Chlorantraniliprole 18.5 SC	Coragen	0.02 %	54.11 (47.34)	60.39 (50.98)
Emamectin benzoate 5 SG	Proclaim	0.02 %	100.00 (89.96)	100.00 (89.96)
Streptocycline	Streptocycline	0.05 %	53.33 (46.89)	63.52 (52.83)
S.Em			0.26	0.35
CD @ 1%			1.03	1.40

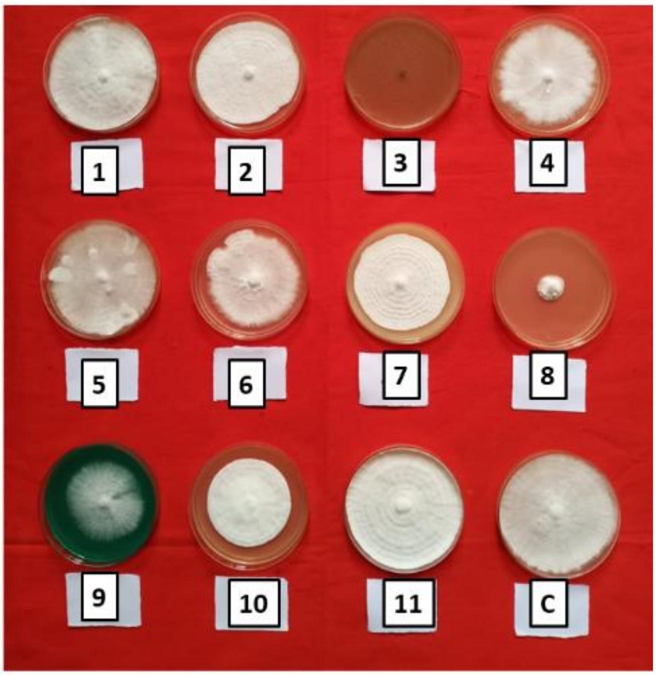

Fig 1: Antifungal activity of insecticides against *P. aphanidermatum ;* 1- Chlorantraniliprole ; 2-Lambda Cyhalothrin ; 3-Emamectin benzoate; 4-Streptocycline ; 5-Flubendiamide ; 6-Novaluron + Emamectin benzoate ; 7-Azardirachtin ; 8-Profenofos ; 9-Spinetoram ; 10-Chloropyriphos;11- Cypermethrin ; C- Control

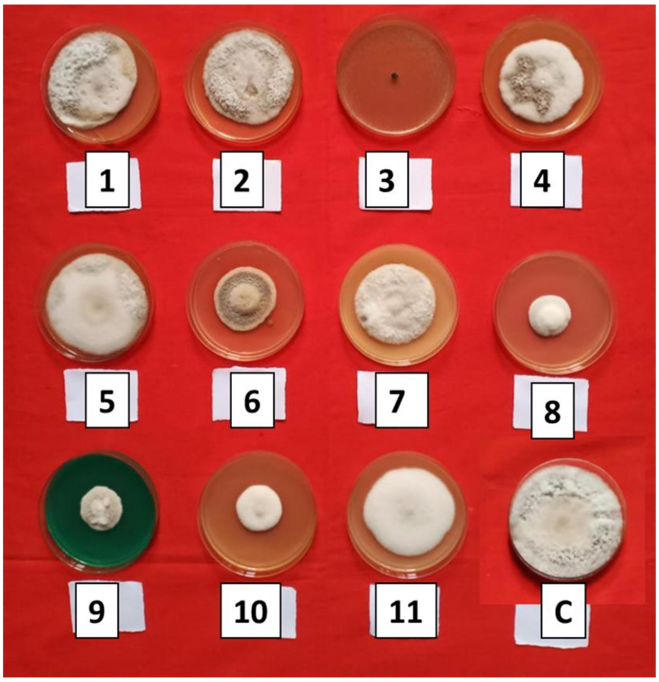

Fig 2: Antifungal activity of insecticides against *A. solani ;* 1-Chlorantraniliprole ; 2-Lambda Cyhalothrin ; 3-Emamectin benzoate; 4-Streptocycline ; 5-Flubendiamide ; 6-Novaluron + Emamectin benzoate ; 7-Azardirachtin ; 8-Profenofos ; 9-Spinetoram ; 10-Chloropyriphos;11- Cypermethrin ; C- Control

Conclusion

The insecticides, Emamectin benzoate 5 SG (Proclaim) and Profenofos 50 EC were found to have excellent fungicidal properties. These insecticides completely inhibited fungal pathogen at their recommended concentration. Most of the evaluated insecticides showed more than 50.00 per cent of fungal inhibition. Hence, in future these can be used for simultaneous management of insect pests and diseases with single application. Since it was laboratory study, field level evaluation is required in future for successful exploitation of antifungal property of insecticides. It is the first research proof for the antifungal activity of commercial insecticides.

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