International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(5): 239-241

Received: 09-07-2018
Accepted: 13-08-2018

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Efficacy of local isolates of entomopathogenic fungi against thrips, *Scirtothrips dorsalis* and fruit borer, *Spodoptera litura*

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Abstract
Pesticides are playing a prime role in the management of pests in both fields of agriculture and horticulture. Descriminate use of the pesticides has lead to the several ecological consequences. Alternative approach consisting of ecofriendly components is most preferable. Local isolates of entomopathogenic fungi would serve as safe alternative approach. In this view, Laboratory experiment was carried out at KRCCH, Arabhavi to evaluate the local isolates of entomopathogenic fungi against thrips and fruit borer in comparision with the commercial formulation. The experiment consisted of nine treatments with five replications (thrips) and four replications (*S. litura*). Among the different treatments, local isolates of *Lecanicillium lecanii* at $2X10^8$ and *Nomuraea rileyi* at $2X10^8$ and $4X10^8$ proved to be effective against thrips and *S. litura*, respectively and were found to be significantly superior over the commercial formulations.

Keywords: *Lecanicillium lecanii*, *Nomuraea rileyi*, thrips, fruit borer

1. Introduction
Agriculture plays a prominent role by assuring the food security to the increasing population of the country. In India, it is estimated that, insects pests cause about 33 per cent of loss and has been estimated to be 200 billion annually (Devi *et al.*, 2012) [1]. Inorganic pesticides play an important role in plant protection methods. It has been estimated a benefit cost ratio of approximately 4:1 for the benefits and cost of chemical pesticide (Pimentel, 1997) [8]. However, insecticides have been realized for its theoretical drawbacks within the environment. Extensive use of insecticides has led to the disruption of ecosystems because such as death of non-target species, the accumulation of pesticide residues in the environment and food and the build up of pesticide resistance in the target species (FAO, 1989; Devonshire, 1989) [4, 3]. Hence, a sustainable and ecofriendly management approach like use of biological control methods serves as a best practice in order to minimize the indiscriminate and injudicious use of chemical pesticides. Entomopathogenic fungi with its cosmopolitan existence and rich diversity offers as a sustainable solution towards the menace of insecticides. The main route of entry is through integument and may also infect the insect by ingestion or through wounds or trachea (Holder *et al*, 2005) [6]. These fungi exhibits a high level of variation among the isolates with respect to pathogenicity, virulence and viability and environmental conditions. In this context, laboratory experiment was conducted by using the thrips and fruit borer as a test insect.

2. Material and Methods
2.1 Collection and rearing of thrips and fruit borer
Thrips were collected from the chilli field while fruit borer, *S. litura* were collected from marigold field located at KRCCH, Arabhavi. Thrips were reared on the chilli fruits while *S. litura* were reared on the castor leaves till next generation so that uniform instars could be used for the studies.

2.2 Efficacy study against thrips
To evaluate the bio efficacy of local isolates of entomopathogenic fungi, Complete Randomized design with five replications was followed. Each petriplates served as a

replication and were placed with a blotting paper and 5 cm leaf disc of cotton. About 10 thrips were inoculated to each petriplates with the zero size paint brush under stereo binocular microscope (to prevent the damage during innoculation). Leaf dip method was used for treatment imposition.

2.3 Efficacy study against fruit borer

Here four replications were followed. Each petriplates were placed with the 8 cm disc of Castor leaves and 5 second instar larvae were inoculated. Then, the treatments were imposed with the help of Ganesh sprayer. The treatment details are mentioned below.

T_1	Spray with *Lecanicillium lecanii* @ 2 g/l
T_2	Spray with *Lecanicillium lecanii* @ 4 g/l
T_3	Spray with *Nomureae rileyi* @ 2 g/l
T_4	Spray with *Nomureae rileyi* @ 4 g/l
T_5	Spray with *L. lecanii* and *N. rileyi* @ 2 g/l
T_6	Spray with *L. lecanii* and *N. rileyi* @ 4 g/l
T_7	Commercially available *L. lecanii* @ 2 g/ l
T_8	Commercially available *N. rileyi* @ 2 g/ l
T_9	Spray Azadirachtin 10000 ppm @ 1 ml/l

Commercial formulations were procured from UAS, Dharwad and treatments were imposed keeping Azadirachtin as a check.

Statistically analysis

The mean of the per cent mortality of the insects was transformed to arcsine transformation and was then subjected to ANOVA by using WASP software package and the treatment effects were compared by following Duncan Multiple Range Test (DMRT).

3. Results and Discussion

The mortality significantly increased at two, four, six and eight days after the treatment imposition in both local and commercial *L. lecanii* formulations against thrips. The highest mortality *i.e.*50% was recorded by the local isolate of *L. lecanii* at 2 $X10^8$ g/l which was 52 per cent higher than Azadirachtin (28 %) and commercial formulation (24 %) due to higher toxic effect of *L. lecanii* and region specificity. No significant differences were observed among the treatments consisting of local isolates of *L. lecanii* (Table 1). However, local isolate of *N. rileyi* was not effective on the thrips and recorded zero per cent mortality due to its host specificity. The present findings are in corroboration with the study carried out by Gokak *et al*. (2007) [5] who evaluated the local isolates of *L. lecanii* against *M. persicae* and reported 100, 96.67 per cent mortality by R7BGBD and R8GAR isolates, respectively after 10 days of treatment imposition at 2 X 10^9 cfu/ml. Analogously, Diaz *et al.* (2009) [2] evaluated virulence of four *L. lecanii* isolates against aphid, *M. persicae* and recorded that ICAL6 isolate was virulent with 95 per cent mortality and was highest to the commercial product *Viz.* Vertalec (91.6 %).

In case of fruit borer, mortality commenced from third day after treatment imposition. Mortality increased at three, six, nine and twelve days after the treatment. The treatment consisting of local isolate of *N. rileyi i.e* at $2X10^8$, 4 X 10^8 and in combination with *L. lecanii* at 2g/l registered the maximum mortality (95%) and was superior to the commercial formulation (75%) and Azadirachtin (50%) while minimum mortality was observed in treatments containing *L. lecanii* (Table 2). The findings were in agreement with Rajan and Muralikrishnan (2009) [9] who revealed 83.40, 76.60 and 70.60 per cent mortality at I, II and III instars of *S. litura*, respectively by the PDBC isolate of *N. rileyi*. Similarly, Padnad and Krishnaraj (2009) [7] tested the pathogenecity of different isolates and reported that, NR-D and NR-R isolate of *N. rileyi* registered maximum of 96.7 and 93.3 per cent mortality in *S. litura* and *H. armigera* at 1 X 10^8 conidia/ml.

Table 1: Bio-efficacy of local isolates of entomopathogenic fungi against thrips, *Scirtothrips dorsalis*

Treatments	Mortality (%)			
	2 DAS	4 DAS	6 DAS	8 DAS
T_1 - *L. lecanii* @ 2 g/l	32.00 (30.86)^a	40.00 (34.38)^a	50.00 (44.95)^a	50.00 (44.95)^a
T_2 - *L. lecanii* @ 4 g/l	26.00 (27.83)^a	38.00 (37.17)^a	44.00 (40.85)^{ab}	46.00 (41.99)^{ab}
T_3 - *N. rileyi* @ 2 g/l	4.00 (6.04)^b	4.00 (6.04)^{bc}	4.00 (6.04)^c	4.00 (6.04)^c
T_4 - *N. rileyi* @ 4 g/l	4.00 (6.04)^b	4.00 (6.04)^{bc}	4.00 (6.04)^c	4.00 (6.04)^c
T_5 - *L. lecanii* + *N. rileyi* @ 2 g/l	18.00 (20.19)^{ab}	30.00 (30.19)^a	42.00 (40.34)^{ab}	48.00 (42.70)^{ab}
T_6 - *L. lecanii* + *N. rileyi* @ 4 g/l	4.00 (6.04)^b	16.00 (21.43)^{ab}	26.00 (27.78)^{ab}	26.00 (27.78)^{ab}
T_7 - Commercial *L. lecanii* @ 2 g/l	12.00 (13.71)^{ab}	22.00 (27.97)^a	24.00 (26.63)^b	24.00 (26.63)^b
T_8 - Commercial *N. rileyi* @ 2g/l	0.00 (0.91)^b	0.00 (0.91)^c	0.00 (0.91)^c	0.00 (0.91)^c
T_9 - Azadirachtin 10000 ppm @ 1 ml/l	16.00 (18.59)^{ab}	24.00 (29.33)^{ab}	28.00 (28.99)^{ab}	28.00 (28.99)^{ab}
CD (p=0.05)	19.36	18.98	17.42	17.36
S.Em.±	6.75	6.62	6.08	6.05

DAS- Days after spray Figures in the parenthesis are arc sine transformed values

In a column, means followed by same alphabet do not differ significantly (p= 0.05) by DMRT

Table 2: Bioefficacy of entomopathogenic fungi on fruit borer, *Spodoptera litura*

Treatments	Mortality (%)			
	3 DAS	6 DAS	9 DAS	12 DAS
T_1 - *L. lecanii* @ 2 g/l	0.00 (1.28)^c	0.00 (1.28)^e	0.00 (1.28)^d	0.00 (1.28)^d
T_2 - *L. lecanii* @ 4 g/l	0.00 (1.28)^c	0.00 (1.28)^e	0.00 (1.28)^d	0.00 (1.28)^d
T_3 - *N. rileyi* @ 2 g/l	55.00 (47.88)^b	90.00 (76.08)^a	95.00 (82.40)^a	95.00 (82.40)^a
T_4 - *N. rileyi* @ 4 g/l	70.00 (57.11)^a	85.00 (72.91)^{ab}	95.00 (82.40)^a	95.00 82.40)^a
T_5 - *L. lecanii* + *N. rileyi* @ 2 g/l	50.00 (45.00)^b	75.00 (60.26)^{bc}	85.00 (69.76)^{ab}	85.00 (69.76)^{ab}
T_6 - *L. lecanii* + *N. rileyi* @ 4 g/l	55.00 (47.88)^b	90.00 (76.08)^a	95.00 (82.40)^a	95.00 (82.40)^a
T_7 - Commercial *L. lecanii* @ 2 g/l	0.00 (1.28)^c	0.00 (1.28)^e	0.00 (1.28)^d	0.00 (1.28)^d
T_8 - Commercial *N. rileyi* @ 2 g/l	50.00 (45.00)^b	70.00 (57.11)^{cd}	75.00 (60.26)^b	75.00 (60.26)^b

T_9 - Azadirachtin 10000 ppm @ 1 ml/l	45.00 (41.83)[b]	50.00 (45.00)d	50.00 (45.00)[c]	50.00 (45.00)[c]
CD (p=0.05)	8.95	14.70	13.02	13.02
S.Em.±	3.08	5.06	4.48	4.48

DAS-Days after spray Figures in the parenthesis are arc sine transformed values
In a column, means followed by same alphabet do not differ significantly (p= 0.05) by DMRT

4. Conclusion

Entomopathogenic fungi is geographic specific and exhibit variation among the isolates with respect to the pathogenicity, virulence and variability. Therefore, bio efficacy of these isolates should be determined. The present findings also showed that, local isolates were more effective than the commercial formulations. Hence, the local isolates of entomopathogenic fungi proves to be efficient than the commercial formulations and could be isolated locally.

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