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Compatibility of *B. bassiana* with different insecticides

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Abstract
Among the various insecticides tested with *B. bassiana*, chlorantraniliprole 0.006 per cent recorded highest radial growth and found most compatible with *B. bassiana*. The other insecticides *viz,* deltamethrin 0.005 per cent, thiodicarb 0.075 per cent, emamectin benzoate 0.0015 per cent and flubendiamide 0.007 per cent were also found equally compatible with *B. bassiana*. While, Indoxacarb 0.0075 per cent and fenvalrate 0.015 per cent recorded the least radial growth and thus found less compatible with *B. bassiana*.

Keywords: Compatibility, *B. bassiana*, Insecticides

Introduction
Entomopathogenic fungi are important natural control agents of many insects, including several pests (Carruthers and Hural, 1990) [4]. Biological control, in particular when accomplished by entomopathogens, is a technique that should be considered as an important pest population density reduction factor in Integrated Pest Management (IPM) programs. Therefore, the conservation of such entomopathogens, whether they occur naturally or when they are applied or introduced to control insects, is an interesting practice. However, the use of incompatible insecticides may inhibit the development and reproduction of these pathogens, affecting IPM (Anderson and Roberts, 1983) [2]. On the other hand, the utilization of selective insecticides in association with pathogens can increase the efficiency of control, allowing the reduction of the amount of applied insecticides, minimizing environmental contamination hazards and the expression of pest resistance (Quintela and McCoy, 1998) [10]. The objective of this study was to evaluate the *in vitro* fungitoxic effect (selectivity /compatibility) of some newer insecticides in relation to the entomopathogenic fungus *Beauveria bassiana,* an important natural control agent. Thus, the present study will be useful to generate some information regarding compatibility of fungal bio-pesticide with some newer insecticides and increasing the effectiveness of bio-pesticides for managing the pest.

Materials and Methods
An experiment was carried out to ascertain the compatibility of *B. bassiana* with different insecticides. The details of the experiment are as under.

1. Title of experiment : Compatibility of *B. bassiana* with different insecticides
2. Location : Biocontrol Laboratory, Department of Entomology, College of Agriculture, JAU, Junagadh
3. Design : CRD
4. Replication : 03
5. Treatment : 10

Table 1: List of insecticides use for compatibility with *B. Bassiana*

Sr. No.	Common name	Formulation	Concentration (%)
1.	Cypermethrin	10 EC	0.01
2.	Deltamethrin	2.8 EC	0.005
3.	Emamectin benzoate	5 SC	0.0015
4.	Chlorantraniliprole	20 SC	0.006
5.	Fenvalerate	20 EC	0.015
6.	Flubendiamide	480 SC	0.007
7.	Indoxacarb	15 SC	0.0075
8.	Lambda cyhalothrin	5 EC	0.01
9	Thiodicarb	75 WP	0.075
10.	Spinosad	45 SC	0.009
11.	Control	-	-

Application of treatment

Ten insecticides were evaluated by poisoned food technique (Moorhouse *et al*., 1992) [7] in Potato Dextrose Agar (PDA) medium for the radial growth and germination of *B. bassiana*. Twenty ml of PDA medium was sterilized in individual boiling tubes and the insecticide emulsions of required concentration was incorporated into the melted sterile PDA aseptically, thoroughly mixed, poured into 9 cm diameter sterile petri dishes and allowed to solidify under laminar flow cabinet. An agar disc along with mycelium mat of *B. bassiana* was cored from the periphery of 10 day old colony of *B. bassiana* by 4 mm diameter cork borer and transferred in to the centre of the PDA plate. Growth medium (PDA) without insecticide but inoculated with mycelia disc served as untreated check. The plates was sealed with parafilm and incubated at room temperature up to full growth obtained in control. Each treatment was replicated thricer. The diameter of growing culture in excess of the plugs in each petri dish was measured.

Method of recording the observations

Radial growth of the entomogenous fungus was recorded, when full growth was obtain with control. The per cent inhibition in radial growth over control was calculated as per the following equation given by Bliss (1934) [3].

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

Where;

I = Per cent inhibition

C = Colony diameter of control plate

T = Colony diameter of treated plate

Results and Discussion

Compatibility of *B. bassiana* with different insecticides

Compatibility of *B. bassiana* was tested with commonly used insecticide by poison food technique PDA (Potato Dextrose Agar) media. Radial growth and per cent inhibition of the fungus was recorded when full growth obtained with control (7th day of incubation).

Almost all the insecticides used in test were found more or less inhibitory for the growth of *B. bassiana* (Table 2). Perusal of data on radial growth (Table 2) indicated that chlorantraniliprole 0.006 per cent recorded the highest radial growth (71.48 mm). The treatments of deltamethrin 0.005 per cent, thiodicarb 0.075 per cent and emamectin benzoate 0.0015 per cent remained next in order which registered 69.26, 69.21 and 68.52 radial growth, respectively. Indoxacarb 0.0075 per cent showed significantly lowest radial growth which recorded 48.52 mm radial growth followed by fenvalrate 0.015 per cent (51.86 mm). The remaining treatments flubendiamide 0.007 per cent, spinosad 0.009 per cent, cypermethrin 0.01 per cent and lambda cyhalothrin 0.01 per cent recorded moderate radial growth which registered 67.41, 66.67, 65.34 and 64.81mm, respectively.

The results recorded on growth inhibition of *B. bassiana* (Table 2) indicated that chlorantraniliprole 0.006 per cent showed significantly lowest growth inhibition (18.77 %). The treatments of deltamethrin 0.005 per cent, thiodicarb 0.075 per cent and emamectin benzoate 0.0015 per cent were found next in order which recorded 21.56, 21.62 and 22.52 per cent growth inhibition, respectively. Indoxacarb 0.0075 per cent and fenvalrate 0.015 per cent showed significantly highest growth inhibition, which recorded 52.32 and 47.09 per cent growth inhibition, respectively. The treatment of flubendiamide 0.007 per cent, spinosad 0.009 per cent, cypermethrin 0.01 per cent and lambda-cyhalothrin 0.01 per cent showed moderately growth inhibition of *B. bassiana* as they inhibited 25.00, 26.62, 27.27 and 23.99 per cent radial growth, respectively.

The present results indicated that chlorantraniliprole proved to be poorest inhibitor of *B. basssiana* growth followed by deltamethrin, thiodicarb and emamectin benzoate. The insecticide *i.e.* Spinosad, cypermethrin and lambda cyhalothrin found moderately inhibitors while, indoxacarb and fenvalrate were found to be strong inhibitors for *B. bassiana* growth. Thus, the chlorantraniliprole, deltamethrin, thiodicarb, Emamectin benzoate, flubendiamide, Spinosad, cypermethrin and lambda cyhalothrin found most compatible with entomogenous fungi, *B. bassiana.* Indoxacarb and fenvalrate were found less compatible with entomogenous fungi, *B. bassiana.* According to Shoutao *et al*. (2002) [9] and Masarrat (2009) [6] fenvalerate 20% EC, greatly reduced the germination rate of *B. bassiana* at the field-spray concentrations recommended. Gosselin *et al*. (2009) [5] tested the compatibility of spinosad and *Beauveria bassiana.* Pinnamaneni and Kalidas (2009) [8] reported that Lambda cyhalothrin was more compatible with *Beauveria bassiana.* Amutha, *et al*. (2010) [1] found that spinosad 45 SC and thiodicarb 75 WP were slightly toxic whereas, indoxacarb 14.5 EC was highly toxic. Thus, present finding collaborate the results reported by earlier workers.

Table 2: Effect of different insecticides on the radial growth of *B. Bassiana*

Sr. No.	Treatments	Concen. (%)	Radial growth (mm) after seven days of inoculations	Growth inhibition (%) After seven days of inoculation
1.	Cypermethrin 10 EC	0.01	65.34	31.19* (26.82)
2.	Deltamethrin 2.8 EC	0.005	69.26	27.67 (21.56)
3.	Emamectin benzoate 5 EC	0.0015	68.52	28.33 (22.52)
4.	Chlorantraniliprole 20 SC	0.006	71.48	25.67 (18.77)
5.	Fenvalerate 20 EC	0.015	51.86	43.33 (47.09)
6.	Flubendiamide 480SC	0.007	67.41	29.33 (23.99)
7.	Indoxacarb 15 SC	0.0075	48.52	46.33 (52.32)
8.	Lambda cyhalothrin 5 EC	0.01	64.81	31.67 (27.57)

9	Thiodicarb 75 WP	0.075	69.21	27.71 (21.62)
10.	Spinosad 45 SC	0.009	66.67	30.00 (25.00)
11.	Control	-	90.00	-
	S.Em. ±			1.23
	C.D. at 5%			3.63
	C.V.%			6.64
* Angular transformation. Figures in parentheses are retransformed values.				

Conclusion
Based on the present study results, it can be concluded that the the chlorantraniliprole, deltamethrin, thiodicarb, emamectin benzoate, flubendiamide, spinosad, cypermethrin and lambda cyhalothrin found most compatible with entomogenous fungi *B. bassiana*. However, indoxacarb and fenvalrate were found less compatible with entomogenous fungi *B. bassiana*.

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