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Evaluation of biorational insecticides against sucking pest complex of cucumber and their impact on natural enemies

PS Rahane, SA Pawar, CS Patil and YS Saindane

Abstract
An experiment entitled “Evaluation of biorational insecticides against major pest complex of cucumber (*Cucumis sativus* L.)” was conducted at the All India Co-ordinated Research Project on Vegetable Crops, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar (Maharashtra) during *kharif* 2022. During the course of study, six sequential strategies with untreated control were evaluated against sucking pest complex of cucumber. The results showed that treatment with spraying of *Lecanicillium lecanii* @ 5 g/l *fb* NSE 5% *fb Metarhizium anisopliae* @ 5 g/l was found to be most effective and recorded least average survived population of aphids, thrips and whitefly and it was at par with spraying of *Lecanicillium lecanii* @ 5 g/l *fb* Pongamia oil 0.5% *fb Metarhizium anisopliae* @ 5 g/l. However, treatment with spraying of *Beauveria bassiana* at 5 g/l *fb* Pongamia oil 0.5% *fb Metarhizium anisopliae* at 5 g/l observed as safer and recorded highest coccinellid grub population which observed at par with spraying of *Beauveria bassiana* @ 5 g/l *fb* NSE 5% *fb Metarhizium anisopliae* @ 5 g/l.

Keywords: Cucumber, aphids, thrips, whitefly, biorational insecticides, sequential strategy

Introduction

Cucumber is prominent vegetable crop belonging to the Cucurbitaceae family, locally known as "Kakadi" and extensively cultivated throughout Maharashtra. Cucurbits, encompassing 118 genera and 825 species, are grown in various tropical and subtropical countries worldwide (Laila *et al*., 2015) [15]. Notably, it stands as the oldest and important crop within the cucurbitaceae family commonly utilized for pickles or salads. Cucumber has nutritional value provides carbohydrates (1%), daily fiber (3%), vitamin C (4%) potassium (4%) and iron, calcium, magnesium, Vitamin A in a small quantity (Szalay, 2017) [20]. The attack of sucking pest complex is one of the significant factors limiting cucumber cultivation, they damage the crop by sucking cell sap and devitalise the plant. Initially aphids manifest their damage through the downward curling and crinkling of leaves. These pests extract plant fluids from stems, leaves, and other tender plant parts by piercing them with their slender mouthparts. The species of thrips gained the status of major pest of vegetables. Thrips have rasping and sucking type mandibles hence they just scrap the epidermal cells and sucking oozing cell sap. Direct damage caused by feeding puncture, results in necrosis of leaves. Rusty brown colour apparance is seen of fruits of cucumber. The whitefly stands out as important insect pest affecting cucumber crops worldwide. Both adult and nymph stages of the whitefly feed on extracting sap from the under surface of leaves, leading to a reduction in plant vitality and stunted vegetative growth in severe cases of infestation. The honeydew excreted by all stages of the whitefly accumulates on foliage and fruit, creating sites for the development of sooty mold (*Capnodium* spp.). To address issues in vegetable cultivation, farmers resort to an extensive application of chemical pesticides. Farmers extensively employ contact, systemic insecticides and synthetic pyrethroids to successfully control the pest. Meanwhile, the repeated application of chemicals from the same group is undesirable, as it may lead to issues such as resurgence, resistance and residues. Hence, adopting a sequential strategy involving botanical and microbial pesticides is pursued to cultivate healthy and high-quality crop. To mitigate the risk associated with chemical insecticides, the current investigation aims to evaluate eco-friendly pest management options for the sucking pest complex in cucumber.

Materials and Methods

A field trial with six sequential strategy along with untreated control (Table 1) was carried out in Randomized Block Design with three replications, during *kharif* 2022 at All India Coordinated Research Project on Vegetable Crops at MPKV, Rahuri for the management of sucking pest complex on cucumber. The seeds of cucumber variety 'Gypsy+ was sown during 2nd fortnight of Augest in a plot size 4.0 ×3.0 m. with plant spacing 1.5 × 0.5 m. In each sequential strategy, three sprays were applied at 10 days interval by using 500 lit. of water per hectare with the help of hand operated knapsack sprayer as pest appearance starting from 30 days after sowing. The treatments are illustrated in (Table 1). In order to find out effective sequential strategy for control of sucking pest complex in cucumber, five plants from each treatment plot were selected randomly and tagged for recording the observations. The nymphs of thrips on three leaves (bottom, middle and top), whitefly population on three leaves (bottom, middle and top), aphid population on three leaves (bottom, middle and top) observed and their numbers were recorded on three leaves per plant. Similarly, natural enemies count of coccinellid grubs was taken after each spray. The observations were recorded a day before treatment application as pre-count, and then at 3rd, 7th and 10th days after each spraying as post-counts.

Table 1: Treatment details

Treatment No.	Treatment
T_1	*Beauveria bassiana* @ 5 g/l *fb* NSE 5% *fb Metarhizium anisopliae* @ 5 g/l.
T_2	*Lecanicillium lecanii* @ 5 g/l *fb* NSE 5% *fb Beauveria bassiana* @ 5 g/l.
T_3	*Lecanicillium lecanii* @ 5g/l *fb* NSE 5% *fb Metarhizium anisopliae* @ 5 g/l.
T_4	*Beauveria bassiana* @ 5 g/l *fb* Pongamia oil 0.5% *fb Metarhizium anisopliae* @ 5 g/l.
T_5	*Lecanicillium lecanii* @ 5g/l *fb* Pongamia oil 0.5% *fb Beauveria bassiana* @ 5 g/l
T_6	*Lecanicillium lecanii* @ 5 g/l *fb* Pongamia oil 0.5% *fb Metarhizium anisopliae* @ 5 g/l.
T_7	Untreated control

Results and Discussion

It is revealed from the pooled data (Table 2-4), that all the sequential strategy treatments were found significantly superior over untreated control for control of sucking pests on cucumber.

Effective sequential strategies for control of aphids (*Aphis gossypii* Glover) in cucumber

The results from Table 2 revealed that all treatments were found to be superior over untreated control (18.11 aphids/3 leaves/plant) in minimizing pest population. The treatment with spraying of *Lecanicillium lecanii* @ 5 g/l *fb* NSE 5% *fb Metarhizium anisopliae* @ 5 g/l observed as most effective recorded aphid population (6.83 aphids/3 leaves/plant) and found equally effective with spraying of *Lecanicillium lecanii* @ 5 g/l *fb* Pongamia oil 0.5% *fb Metarhizium anisopliae* @ 5 g/l (7.43 aphids/3 leaves/plant). The treatment with spraying of *Beauveria bassiana* @ 5 g/l *fb* Pongamia oil 0.5% *fb Metarhizium anisopliae* @5 g/l (11.40 aphids/3 leaves/plant) was comparatively less effective among all treatments.

Result in respect of effectiveness of *Lecanicillium lecanii* for aphids documented by Oztopal and Elmastas (2022) [17] and Bade *et al.* (2017) [3]. Effectiveness of NSE 5% against aphids was earlier shown by Mandal *et al*. (2006) [16] and Ghosh (2017) [10]. From the present study it can be conclude that the spraying *Lecanicillium lecanii* fungi was more efficient than *Beauveria bassiana* in suppressing the number of aphids was earlier reported by Janghel *et al.* (2015) [12] which are in conformity with the present investigation.

Effective sequential strategies for control of thrips (*Thrips palmi* Karny) in cucumber

The data related to cumulative effect of different sequential strategies on thrips population is presented in Table 3

From pooled mean it was observed that, treatment with spraying of *Lecanicillium lecanii* @ 5 g/l *fb* NSE 5% *fb Metarhizium anisopliae* @ 5 g/l (4.61 thrips/3 leaves/plant) maintained its superiority against 13.41 thrips/3leaves/plant observed in untreated plot with highest population. However, it was at par with spraying of *Lecanicillium lecanii* @ 5 g/l *fb* Pongamia oil 0.5% *fb Metarhizium anisopliae* @ 5 g/l (5.12 thrips/3 leaves/plant). In order of efficacy, treatment with spraying of *Beauveria bassiana* @ 5 g/l *fb* Pongamia oil 0.5% *fb Metarhizium anisopliae* @5 g/l (7.69 thrips/3 leaves/plant) was found less effective sequence.

The earlier studies conducted by Bhojane *et al.* (2019) [4] and Chaudhari *et al*. (2017) [5] demonstrated the effectiveness of *Lecanicillium lecanii* and *Metarhizium anisopliae* and these findings in line with the current analysis. Similar results were reported by Azaizeh *et al.* (2002) [2] and Ramarethinam *et al*. (2002) [19] and they are identical with the current analysis. Similarly, Krishnamoorthy *et al.* (2013) [14] reported efficacy of NSE 5% against thrips which are in accordance with present research.

Effective sequential strategies for control of whitefly (*Bemisia tabaci* Gennadius) in cucumber

It is evaluated from the cumulative results obtained from Table 4 that, all the sequential strategies evaluated were significantly superior over untreated control (15.25 whitefly/3 leaves/plant) in reducing the whitefly population recorded at 3,7 and 10 days after each spray. Among all different treatments spraying of *Lecanicillium lecanii* @ 5 g/l *fb* NSE 5% *fb Metarhizium anisopliae* @ 5 g/l was found most superior over all treatments and recorded lowest population (4.06 whitefly/3leaves/plant). Whereas, spraying of *Lecanicillium lecanii* @ 5 g/l *fb* Pongamia oil 0.5% *fb Metarhizium anisopliae* @ 5 g/l (4.61 whitefly/3leaves/plant) found at par with this treatment. The least effective treatment with spraying of *Beauveria bassiana* @ 5 g/l *fb* Pongamia oil 0.5% *fb Metarhizium anisopliae* @ 5 g/l recorded maximum population 9.47 whitefly/3 leaves/plant.

Earlier studies carried out by Ghongade and Sangha (2021) [9] revealed that *Lecanicillium lecanii* at 5 g/l and *Metarhizium anisopliae* at 5 g/l were effective against whitefly, which is in agreement with the current findings. Similarly, Chouikhi *et al.* (2023) [6], Kekan *et al.* (2022) [13] also confirmed the superiority of *Lecanicillium lecanii* for controlling the whitefly population. In context of the present investigation, Ali *et al.* (2017) [1] and Dimetry *et al.* (1996) [8] reported that NSE 5% has been identified as promising for controlling whitefly.

Impact of different sequential strategies on coccinellid predators

Result from Table 5 revealed that, the treatment with spraying of *Beauveria bassiana* @ 5 g/l *fb* Pongamia oil 0.5% *fb* *Metarhizium anisopliae* @ 5 g/l (3.47 grubs/plant) was safer and recorded highest coccinellid grub population which was at par with spraying of *Beauveria bassiana* @ 5 g/l *fb* NSE 5% *fb Metarhizium anisopliae* @ 5 g/l (3.42 grubs/plant) The treatment with spraying of *Lecanicillium lecanii* @ 5 g/l *fb* NSE 5% *fb Beauveria bassiana* @ 5 g/l (3.18 grubs/plant) ranked as next better treatments. The current study is in agreement with the findings of Desai *et al.* (2013) [7], Hoelmer *et al.* (1990) [11] who noticed that the NSE 5% was not affect the population of coccinellid predators and has no detrimental effects on natural enemies. Pawar *et al.* (2019) [18] reported that *Metarhizium anisopliae, Lecanicillium lecanii* was not toxic to the coccinellid predators.

Table 2: Cumulative effect of different sequential strategies on aphids (*Aphis gossypii* Glover) population of cucumber. (Av. of 3 sprays)

Sr. No.	Treatments	Number of aphids/3 leaves/plant			
		3 DAS	7 DAS	10 DAS	Mean
1	Spraying of *Beauveria bassiana* @ 5 g/l *fb* NSE 5% *fb Metarhizium anisopliae* @ 5 g/l	10.93 (3.38)	9.12 (3.10)	9.84 (3.22)	9.96 (3.23)
2	Spraying of *Lecanicillium lecanii* @ 5 g/l *fb* NSE 5% *fb Beauveria bassiana* @ 5 g/l	10.33 (3.29)	8.51 (3.00)	9.39 (3.14)	9.41 (3.15)
3	Spraying of *Lecanicillium lecanii* @ 5 g/l *fb* NSE 5% *fb Metarhizium anisopliae* @ 5 g/l.	8.02 (2.92)	5.90 (2.53)	6.56 (2.66)	6.83 (2.71)
4	Spraying of *Beauveria bassiana* @ 5 g/l *fb* Pongamia oil 0.5% *fb Metarhizium anisopliae* @ 5 g/l.	12.08 (3.55)	10.70 (3.35)	11.43 (3.45)	11.40 (3.45)
5	Spraying of *Lecanicillium lecanii* @ 5 g/l *fb* Pongamia oil 0.5% *fb Beauveria bassiana* @ 5 g/l.	10.01 (3.24)	8.47 (2.99)	9.03 (3.09)	9.19 (3.11)
6	Spraying of *Lecanicillium lecanii* @ 5 g/l *fb* Pongamia oil 0.5% *fb Metarhizium anisopliae* @ 5 g/l.	8.59 (3.01)	6.42 (2.63)	7.28 (2.79)	7.43 (2.82)
7	Untreated control	17.72 (4.27)	18.13 (4.32)	18.48 (4.36)	18.11 (4.31)
	SE ±	0.07	0.08	0.08	0.08
	CD at 5%	0.22	0.25	0.24	0.24

*Figures in parentheses are $\sqrt{X + 0.5}$ transformed values
DAS: Days after spray

Table 3: Cumulative effect of different sequential strategies on thrips (*Thrips palmi* Karny) population of cucumber. (Av. of 3 sprays)

Sr. No.	Treatments	Number of thrips/3 leaves/plant			
		3 DAS	7 DAS	10 DAS	Mean
1	Spraying of *Beauveria bassiana* @ 5 g/l *fb* NSE 5% *fb Metarhizium anisopliae* @ 5 g/l	7.28 (2.79)	6.38 (2.62)	6.58 (2.66)	6.74 (2.69)
2	Spraying of *Lecanicillium lecanii* @ 5 g/l *fb* NSE 5% *fb Beauveria bassiana* @ 5 g/l	6.86 (2.71)	5.94 (2.54)	6.26 (2.60)	6.35 (2.62)
3	Spraying of *Lecanicillium lecanii* @ 5 g/l *fb* NSE 5% *fb Metarhizium anisopliae* @ 5 g/l.	5.18 (2.38)	4.04 (2.13)	4.46 (2.23)	4.61 (2.26)
4	Spraying of *Beauveria bassiana* @ 5 g/l *fb* Pongamia oil 0.5% *fb Metarhizium anisopliae* @ 5 g/l.	8.07 (2.93)	7.28 (2.79)	7.61 (2.85)	7.69 (2.86)
5	Spraying of *Lecanicillium lecanii* @ 5 g/l *fb* Pongamia oil 0.5% *fb Beauveria bassiana* @ 5 g/l.	6.47 (2.64)	5.40 (2.43)	5.62 (2.47)	5.83 (2.52)
6	Spraying of *Lecanicillium lecanii* @ 5 g/l *fb* Pongamia oil 0.5% *fb Metarhizium anisopliae* @ 5 g/l.	5.65 (2.48)	4.69 (2.28)	5.02 (2.35)	5.12 (2.37)
7	Untreated control	13.13 (3.69)	13.22 (3.70)	13.89 (3.79)	13.41 (3.73)
	SE ±	0.08	0.07	0.07	0.07
	CD at 5%	0.25	0.21	0.21	0.22

*Figures in parentheses are $\sqrt{X + 0.5}$ transformed values
DAS: Days after spray

Table 4: Cumulative effect of different sequential strategies on whitefly (*Bemisia tabaci* Gennadius) population of cucumber. (Av. of 3 sprays)

Sr. No.	Treatments	Number of whitefly/3 leaves/plant			
		3 DAS	7 DAS	10 DAS	Mean
1	Spraying of *Beauveria bassiana* @ 5 g/l *fb* NSE 5% *fb Metarhizium anisopliae* @ 5 g/l	8.34 (2.97)	7.42 (2.81)	7.65 (2.85)	7.81 (2.88)
2	Spraying of *Lecanicillium lecanii* @ 5 g/l *fb* NSE 5% *fb Beauveria bassiana* @ 5 g/l	7.60 (2.85)	6.76 (2.69)	7.10 (2.76)	7.15 (2.77)
3	Spraying of *Lecanicillium lecanii* @ 5 g/l *fb* NSE 5% *fb Metarhizium anisopliae* @ 5 g/l.	4.83	3.44	3.91	4.06

		(2.31)	(1.99)	(2.10)	(2.14)
4	Spraying of *Beauveria bassiana* @ 5 g/l *fb* Pongamia oil 0.5% *fb* *Metarhizium anisopliae* @ 5 g/l.	9.79 (3.21)	9.18 (3.10)	9.43 (3.15)	9.47 (3.16)
5	Spraying of *Lecanicillium lecanii* @ 5 g/l *fb* Pongamia oil 0.5% *fb* *Beauveria bassiana* @ 5 g/l.	6.95 (2.73)	6.02 (2.55)	6.50 (2.65)	6.49 (2.64)
6	Spraying of *Lecanicillium lecanii* @ 5 g/l *fb* Pongamia oil 0.5% *fb* *Metarhizium anisopliae* @ 5 g/l.	5.34 (2.42)	4.05 (2.13)	4.43 (2.22)	4.61 (2.26)
7	Untreated control	14.50 (3.87)	15.25 (3.97)	15.99 (4.06)	15.25 (3.97)
	SE ±	0.11	0.08	0.09	0.09
	CD at 5%	0.34	0.26	0.27	0.29

*Figures in parentheses are $\sqrt{X + 0.5}$ transformed values
DAS: Days after spray

Table 5: Cumulative impact of different sequential strategies on coccinellid predators (Av. of 3 sprays)

Sr. No.	Treatments	No. of grubs and adult per plant			
		3 DAS	**7 DAS**	**10 DAS**	**Mean**
1	Spraying of *Beauveria bassiana* @ 5 g/l *fb* NSE 5% *fb* *Metarhizium anisopliae* @ 5 g/l	3.40 (1.98)	3.42 (1.98)	3.45 (1.99)	3.42 (1.98)
2	Spraying of *Lecanicillium lecanii* @ 5 g/l *fb* NSE 5% *fb* *Beauveria bassiana* @ 5 g/l	3.10 (1.90)	3.20 (1.92)	3.23 (1.93)	3.18 (1.92)
3	Spraying of *Lecanicillium lecanii* @ 5 g/l *fb* NSE 5% *fb* *Metarhizium anisopliae* @ 5 g/l.	2.90 (1.84)	2.87 (1.84)	2.91 (1.85)	2.89 (1.84)
4	Spraying of *Beauveria bassiana* @ 5 g/l *fb* Pongamia oil 0.5% *fb* *Metarhizium anisopliae* @ 5 g/l.	3.39 (1.97)	3.47 (1.99)	3.54 (2.00)	3.47 (1.99)
5	Spraying of *Lecanicillium lecanii* @ 5 g/l *fb* Pongamia oil 0.5% *fb* *Beauveria bassiana* @ 5 g/l.	2.97 (1.86)	3.04 (1.88)	3.02 (1.88)	3.01 (1.87)
6	Spraying of *Lecanicillium lecanii* @ 5 g/l *fb* Pongamia oil 0.5% *fb* *Metarhizium anisopliae* @ 5 g/l.	2.94 (1.85)	2.94 (1.86)	2.95 (1.86)	2.94 (1.86)
7	Untreated control	4.43 (2.22)	4.45 (2.23)	4.54 (2.25)	4.48 (2.23)
	SE ±	0.04	0.03	0.02	0.03
	CD at 5%	0.11	0.09	0.06	0.09

*Figures in parentheses are $\sqrt{X + 0.5}$ transformed values
DAS: Days after spray

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