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Field efficacy of different insecticides and bio-pesticides against okra jassid

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Abstract
The experiment was conducted during 2018-19 at BTC CARS, Bilaspur (IGKV), Chhattisgarh to evaluate the insecticides and bio-pesticides against okra jassid under field condition. Two insecticides viz. Cartap hydrochloride 4 G @ 1kg a.i./ha, Fipronil 0.3 G @ 60g a.i./ha and three bio-pesticides viz. *Beauveria bassiana* @ 10g/lit., *Bacillus thuringiensis* @ 2g/lit., *Metarhizium anisopliae* @ 10g/lit. Fipronil 0.3 G soil application after the germination followed by spray with *Beauveria bassiana* was found to be most effective against okra jassid, as it was recorded overall less jassid populatìon (1.62/plant). The maximum jassid populatìon (2.89/plant) was recorded in Cartap hydrochloride 4 G soil application after the germination. Fipronil 0.3 G soil application after the germination followed by spray with *Metarhizium anisopliae* was recorded highest fruit yield (89.89q/ha) with benefit cost ratio 1.38:1.00.

Keywords: Field efficacy, insecticides and bio-pesticides, okra jassid

Introduction
Okra, *Abelmoschus esculentus* (L.) Moench commonly known as *bhindi* or lady's finger (family: Malvaceae) is a popular fruit vegetable crop and said to be originated from Africa. It is an important summer and rainy season vegetable crop grown throughout the world. Vegetables are an indispensable part of our diet, supplying vitamins, carbohydrates and minerals needed for a balanced diet (Randhawa, 1974 and Khan Masood *et al*., 2001) [7, 4].
Total area of okra in India is 511 thousand ha with production of 5849 thousand MT in 2015-16 (Anonymous, 2016) [2]. In Chhattisgarh, the total area of okra is 29.35 thousand ha with 333.13 thousand MT productions (Anonymous, 2015) [1].
According to Rawat and Sahu (1973) [6], okra crop is ravaged by as many as 45 species of insect-pests throughout its growth period. Among these, cotton jassid, *Amrasca biguttula biguttula* (Ishida) and shoot and fruit borers, *Earias vittella* (Fabricius), *E. insulana* (Boisduval) are quite serious and major restraining factors in okra cultivation (Mandal *et al*., 2006) [5].
Atwal and Singh (1990) [3] reported that 59.79 percent losses in okra fruit yield was caused by the jassid alone.

Materials and Methods
The field trial was conducted in the horticultural research field at BTC CARS, Bilaspur (C.G.) during *summer* 2018. The experiment was laid out in randomized block design, replicated thrice with eight insecticides and bio-pesticides treatments along with one untreated plot (Table 1). The okra (Deepika) crop was sown in a plot size of 4.2m × 3m with planting distance of 30cm × 10cm, during second week of March, 2018. The observations were recorded from ten randomly selected plants from each plot on 1 day before and 1, 5, 7 days after each spray. Jassid populatìon was recorded by counting number of Jassid populatìon on three leaves per plant viz. upper, middle and lower leaves.

Table 1: Details of different insecticides and bio-pesticides treatments

S. No.	Treatments	Dose
T1	Cartap hydrochloride 4G soil application after the germination followed by spray with *Beauveria bassiana*	1 kg a.i./ha 10g/lit.
T2	Cartap hydrochloride 4G soil application after the germination followed by spray with *Metarhizium anisopliae*	1 kg a.i./ha 10g/lit.
T3	Cartap hydrochloride 4G soil application after the germination followed by spray with *Bacillus thuringiensis*	1 kg a.i./ha 2g/lit.
T4	Cartap hydrochloride 4G soil application after the germination	1 kg a.i./ha
T5	Fipronil 0.3 G soil application after the germination followed by spray with *Beauveria bassiana*	60 g a.i./ha 10g/lit.
T6	Fipronil 0.3 G soil application after the germination followed by spray with *Metarhizium anisopliae*	60 g a.i./ha 10g/lit.
T7	Fipronil 0.3 G soil application after the germination followed by spray with *Bacillus thuringiensis*	60 g a.i./ha 2g/lit.
T8	Fipronil 0.3 G soil application after the germination	60 g a.i./ha
T9	Untreated Control	-

Result and Discussion

The experimental findings indicated that the treatment found most effective against okra jassid was Fipronil 0.3 G followed by *Beauveria bassiana* (1.62/plant) followed by Cartap hydrochoride 4 G followed by *Metarhizium anisopliae* (1.75/plant), Cartap hydrochoride 4 G followed by *Beauveria bassiana* (1.75/plant), Fipronil 0.3 G followed by *Metarhizium anisopliae* (1.92/plant), Cartap hydrochoride 4 G followed by *Bacillus thuringiensis* (2.16/plant), Fipronil 0.3 G followed by *Bacillus thuringiensis* (2.51/plant), Fipronil 0.3 G (2.76/plant), while the least effective was found to Cartap hydrochoride 4 G (2.89/plant).

The economics of different insecticide and bio-pesticide treatments based on net profit and total cost of cultivation (Table 4) showed that Fipronil 0.3 G followed by *Metarhizium anisopliae* had calculated highest B:C ratio i.e. 1.38:1.00 followed by Cartap hydrochoride 4 G followed by *Bacillus thuringiensis* (1.36:1.00), Cartap hydrochoride 4 G followed by *Metarhizium anisopliae* (1.26:1.00), Cartap hydrochoride 4 G followed by *Beauveria bassiana* (1.21:1.00), Fipronil 0.3 G followed by *Bacillus thuringiensis* (1.12:1.00), Fipronil 0.3 G followed by *Beauveria bassiana* (1.09:1.00), Cartap hydrochoride 4 G (0.54:1.00) and Fipronil 0.3 G (0.52:1.00).

Table 2: Field evaluation of different insecticides and bio-pesticides against okra jassid

S. No.	Treatment	Dose	Mean jassid population (No.)				
			1st Spray				Overall mean
			Before spray	1 DAS	5 DAS	7 DAS	
1	Cartap hydrochoride 4 G followed by *Beauveria bassiana*	1 kg a.i./ha 10g/lit.	2.33 (1.53)	2.05 $(1.43)^{cd}$	1.62 $(1.27)^{bc}$	0.98 $(0.98)^{d}$	1.75 $(1.30)^{bc}$
2	Cartap hydrochoride 4 G followed by *Metarhizium anisopliae*	1 kg a.i./ha 10g/lit.	2.51 (1.58)	2.07 $(1.44)^{cd}$	1.50 $(1.22)^{c}$	0.90 $(0.93)^{d}$	1.75 $(1.29)^{bc}$
3	Cartap hydrochoride 4 G followed by *Bacillus thuringiensis*	1 kg a.i./ha 2g/lit.	2.21 (1.47)	2.22 $(1.44)^{cd}$	2.00 $(1.41)^{b}$	2.21 $(1.49)^{c}$	2.16 $(1.45)^{b}$
4	Cartap hydrochoride 4 G	1 kg a.i./ha	2.32 (1.52)	2.63 $(1.62)^{ab}$	3.02 $(1.74)^{a}$	3.17 $(1.78)^{ab}$	2.89 $(1.67)^{a}$
5	Fipronil 0.3 G followed by *Beauveria bassiana*	60 g a.i./ha 10g/lit.	2.06 (1.43)	1.96 $(1.39)^{d}$	1.54 $(1.23)^{c}$	0.90 $(0.93)^{d}$	1.62 $(1.25)^{c}$
6	Fipronil 0.3 G followed by *Metarhizium anisopliae*	60 g a.i./ha 10g/lit.	2.40 (1.55)	2.30 $(1.52)^{bcd}$	1.86 $(1.36)^{bc}$	1.12 $(1.06)^{d}$	1.92 $(1.37)^{bc}$
7	Fipronil 0.3 G followed by *Bacillus thuringiensis*	60 g a.i./ha 2g/lit.	2.37 (1.54)	2.45 $(1.57)^{abc}$	2.66 $(1.63)^{a}$	2.56 $(1.60)^{bc}$	2.51 $(1.59)^{a}$
8	Fipronil 0.3 G	60 g a.i./ha	2.22 (1.49)	2.53 $(1.59)^{abc}$	3.03 $(1.74)^{a}$	3.24 $(1.80)^{a}$	2.76 $(1.66)^{a}$
9	Untreated control		2.70 (1.64)	2.88 $(1.70)^{a}$	3.13 $(1.77)^{a}$	3.31 $(1.82)^{a}$	3.01 $(1.73)^{a}$
SEm±			0.05	0.03	0.03	0.04	0.04
CD (5%)			NS	0.17	0.18	0.19	0.18

Table 3: Healthy fruit yield and its increase over control as influenced by different treatments

S. No.	Treatment	Healthy fruit yield (q/ha)	Increase in yield over control (q/ha)
1	Cartap hydrochoride 4 G followed by *Beauveria bassiana*	83.73	31.59
2	Cartap hydrochoride 4 G followed by *Metarhizium anisopliae*	85.79	33.65
3	Cartap hydrochoride 4 G followed by *Bacillus thuringiensis*	87.72	35.58
4	Cartap hydrochoride 4 G	56.98	4.84
5	Fipronil 0.3 G followed by *Beauveria bassiana*	78.88	26.74
6	Fipronil 0.3 G followed by *Metarhizium anisopliae*	89.89	37.75
7	Fipronil 0.3 G followed by *Bacillus thuringiensis*	78.35	26.21
8	Fipronil 0.3 G	56.05	3.91
9	Untreated control	52.14	-

Table 4: Cost of cultivation of different treatments against okra jassid

S. No.	Treatment	Healthy fruit yield (q/ha)	Total cost of cultivation (Rs/ha)	Gross income (Rs/ha)	Net income (Rs/ha)	Benefits over control (Rs/ha)	B:C ratio
1	Cartap hydrochoride 4 G followed by *Beauveria bassiana*	83.73	94832.27	209325	114492.73	74219.50	1.21:1.00
2	Cartap hydrochoride 4 G followed by *Metarhizium anisopliae*	85.79	94832.27	214475	119642.73	79369.50	1.26:1.00
3	Cartap hydrochoride 4 G followed by *Bacillus thuringiensis*	87.72	92927.27	219300	126372.73	86099.50	1.36:1.00
4	Cartap hydrochoride 4 G	56.98	92451.77	142450	49998.23	9725.00	0.54:1.00
5	Fipronil 0.3 G followed by *Beauveria bassiana*	78.88	94481.27	197200	102718.73	62445.50	1.09:1.00
6	Fipronil 0.3 G followed by *Metarhizium anisopliae*	89.89	94481.27	224725	130243.73	89970.50	1.38:1.00
7	Fipronil 0.3 G followed by *Bacillus thuringiensis*	78.35	92576.27	195875	103298.73	63025.50	1.12:1.00
8	Fipronil 0.3 G	56.05	92100.77	140125	48024.23	775.001	0.52:1.00
9	Untreated control	52.14	90076.77	130350	40273.23	-	-

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