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Bio-efficacy of insecticides against fruit flies infesting cucumber

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Abstract

The field experiment was carried to evaluate of bio-efficacy of insecticides against fruit flies infesting cucumber during *khariif* season of 2017 at Central Experimental Station, Wakawali, Dist- Ratnagiri. The results on efficacy of insecticides against fruit flies infesting cucumber indicated that spinosad 45 SC @ 0.014 per cent was the best treatment which recorded minimum (15.38%) mean fruit infestation and was at par with emamectin benzoate 5 SG @ 0.002 per cent (20.49%). The next best treatments were azadirachtin (1%) @ 0.003 per cent (27.99%) and malathion 50 EC @ 0.05 per cent (32.89%) which were at par with each other. Similarly, malathion 50 EC @ 0.05 per cent (32.89%) which was at par with deltamethrin 2.8 EC @ 0.0024 per cent and dichlorvos 76 EC @ 0.05 per cent recorded 37.32 and 38.99 per cent fruit infestation, respectively. All the above treatments were found to be superior over untreated control which recorded highest fruit infestation (70.54%).

Keywords: Bio-efficacy, fruit flies, cucumber, insecticides, *Batocera* spp.

Introduction

Cucumber (*Cucumis sativus* L.) belongs to family cucurbitaceae which is used as vegetable crop while its fruits are used for pickle or salad purpose in India. Cucumber provides protein (1%), carbohydrates (1%), potassium (4%), vitamin C (4%) and small amount of iron, calcium, magnesium and vitamin A (Szalay, 2017) [10].

India is the second largest producer of vegetables in the world, next to China, by producing around 171.8 million tonnes of vegetables annually from an area of around 10.1 million hectares. Maharashtra produced vegetables with an annual production of 103.60 lakh tonnes from an area of 6.93 lakh ha (Anon., 2017) [1]. Cucumber has been reported as a commercial cash crop in tropical and sub-tropical parts of India with an annual production of 1.14 million tonnes from an area of 78 thousand hectares and productivity is 15 tonnes per hectare (Anon., 2017) [1].

Cucurbits are attacked by several pests which affect the quality and quantity of produce adversely. Most of the insect-pests cause damage at any stage of plant growth, but some of them are serious at seedling stage *viz.*, red pumpkin beetle, leaf miner, flea beetle, while fruit fly appears at fruiting stage (at crop maturity) (Ram *et al.*, 2009) [6].

Fruit fly belonging to family Tephritidae, order Diptera is the most important pest of cucurbitaceous crops. These are mostly dominant in tropical and sub-tropical areas. Presently, there are 199 species of fruit flies known to occur in India (Chaudhary and Patel, 2012) [2]. The extent of loss inflicted by fruit flies is varying from 30 to 100 per cent depending upon cucurbit species and environmental condition (Dhillon *et al.*, 2005) [3]. Farmers attempted different methods of management like indigenous, chemical, mechanical and combination of two or more methods to control the problems of fruit fly (Sapkota *et al.*, 2010) [8]. Though a number of insecticides have been reported to be effective against this pest but the information in Konkani region is very scanty. Still there were a need to evaluate insecticides to find the most effective one and coupled with other mechanical methods to control fruit fly.

Materials and Methods

The field experiment was carried out at Central Experiment Station, Wakawali, from June 2017 to September 2017. The details of experiment are given in below.

Cultural operations

The land was prepared as per the requirements of cucumber crop and cleared by removing the residues of the previous crop. The experiment was laid out in Randomized Block Design

(RBD). The recommended dose of fertilizers for cucumber is 135:60:30 N:P:K kg ha⁻¹. Nitrogen @ 135 kg ha⁻¹ was applied in three splits doses *viz.*, first dose of 50 per cent N at the time of sowing, second dose of 30 per cent N after 30 days of sowing and remaining 20 per cent dose of N after 60 days of sowing. Phosphorus was applied @ 60 kg ha⁻¹ and potassium was applied @ 30 kg ha⁻¹, these fertilizers were applied in a single dose at the time of sowing.

The experimental area was sown with good seed of cucumber (cv. Sheetal) in each plot. The other agronomic operations *viz.*, intercultural operations and weeding were done as per recommendation.

Details of the field experiment

1. **Cultivar:** Sheetal
2. **Spacing:** 1.50 m × 0.50 m
3. **Total plot size:** 270.60 m²
4. **Date of sowing:** 12th June, 2017
5. **Method of planting:** On small hills
6. **Design:** Randomized Block Design (RBD)
7. **Number of treatment:** Seven
8. **Number of replication:** Three

No.	Insecticides	Concentration (%)
T ₁	Spinosad 45 SC	0.014
T ₂	Azadirachtin 1%	0.003
T ₃	Emamectin benzoate 5 SG	0.002
T ₄	Malathion 50 EC	0.05
T ₅	Dichlorvos 76 EC	0.05
T ₆	Deltamethrin 2.8 EC	0.0024
T ₇	Untreated Control	-

Spraying

The quantity of spray suspension required for each treatment was calibrated by spraying water over three plots in the experiment prior to the application of insecticide. Spray suspension of desired strength of each insecticide was prepared against fruit flies in the field.

The insecticides were sprayed twice. First spray of each insecticide was applied when incidence was noticed on fruits, while the second spray was given at an interval of 15 days with manually operated knapsack sprayer.

Method of recording observations

To study the efficacy of different insecticides against fruit flies, infested fruits were counted in each treatment at 3, 7, 10 and 14 days after application of insecticides. The pre-count observations were recorded one day before application of insecticides. The observations at 14 days after first spray were considered as pre-count observation of second spray. The per cent fruit infestation was computed on the basis of number of infested fruits out of total number of fruits per plot. The data thus obtained were converted into arcsine transformation and then statistically analysed.

$$\text{Per cent fruit infestation} = \frac{\text{No. of infested fruits}}{\text{Total no. of fruits}} \times 100$$

Results and Discussion

Efficacy of insecticides against fruit flies infesting cucumber

1. Efficacy of insecticides against fruit flies infesting cucumber recorded at different intervals after first spray

Data pertaining to the efficacy of some insecticides against fruit flies infesting cucumber are given in Table 1. The data

on efficacy of insecticides revealed that the no infestation of fruit flies was observed on the experimental plot during vegetative phase of the crop and hence the data on infestation during vegetative phase could not be presented. The infestation of the fruit flies prior to application of insecticides ranged from 52.42 to 66.22 per cent. The differences among the treatments and replications were non-significant indicating uniform distribution of pest in both treatments and replications.

The observations recorded on third day after first spray indicated that the treatment spinosad 45 SC @ 0.014 per cent was found to be most effective treatment with 21.50 per cent fruit infestation which was at par with emamectin benzoate 5 SG @ 0.002 per cent which recorded 27.29 per cent fruit infestation. Further it was observed that emamectin benzoate 5 SG @ 0.002 per cent (27.29%) was at par with azadirachtin (1%) @ 0.003 per cent (31.95%). The treatment malathion 50 EC @ 0.05 per cent recorded 40.14 per cent fruit infestation and was at par with the treatments deltamethrin 2.8 EC @ 0.0024 per cent (40.86%) and dichlorvos 76 EC @ 0.05 per cent (44.46%). The maximum (68.88%) per cent fruit infestation was noticed in untreated control.

On the seventh day after spraying the minimum (15.38%) fruit infestation observed in treatment spinosad 45 SC @ 0.014 per cent which was at par with emamectin benzoate 5 SG @ 0.002 per cent which recorded 22.42 per cent fruit infestation. The treatment emamectin benzoate 5 SG @ 0.002 per cent (22.42%) was found at par with azadirachtin (1%) @ 0.003 per cent (28.60%) and malathion 50 EC @ 0.05 per cent (32.81%). Deltamethrin 2.8 EC @ 0.0024 per cent and dichlorvos 76 EC @ 0.05 per cent recorded 37.22 and 37.78 per cent fruit infestation, respectively. The maximum (66.40%) fruit infestation was found in untreated plot.

On 10th day after first spray, the minimum fruit infestation was recorded in the treatment spinosad 45 SC @ 0.014 per cent (18.61%) and which was significantly superior over rest of the treatments. The treatments emamectin benzoate 5 SG @ 0.002 per cent (27.23%) and azadirachtin (1%) @ 0.003 per cent (30.77%) were at par with each other. The treatments *viz.*, malathion 50 EC @ 0.05 per cent, deltamethrin 2.8 EC @ 0.0024 per cent and dichlorvos 76 EC @ 0.05 per cent recorded 37.97, 42.54 and 43.60 per cent fruit infestation, respectively while maximum (72.67%) per cent fruit was observed in untreated plot. At 14th day of observation, the minimum (21.41%) fruit infestation was recorded in spinosad 45 SC @ 0.014 per cent which was at par with emamectin benzoate 5 SG @ 0.002 per cent which recorded 25.33 per cent fruit infestation. The treatment azadirachtin (1%) @ 0.003 per cent recorded 32.33 per cent fruit infestation and malathion 50 EC @ 0.05 per cent recorded 38.00 per cent fruit infestation and both these treatments were at par with each other. Malathion 50 EC @ 0.05 per cent (38.00%) and deltamethrin 2.8 EC @ 0.0024 per cent (41.67%) were at par with each other. The treatment deltamethrin 2.8 EC @ 0.0024 per cent (41.67%) which found at par with dichlorvos 76 EC @ 0.05 per cent (43.67%) while, maximum (71.33%) per cent fruit infestation was observed in untreated control.

The data on cumulative per cent mean infestation revealed that the treatment spinosad 45 SC @ 0.014 per cent was found to be most effective treatment which recorded 19.23 per cent fruit infestation and was at par with emamectin benzoate 5 SG @ 0.002 per cent (25.57%). The treatment emamectin benzoate 5 SG @ 0.002 per cent (25.57%) and azadirachtin (1%) @ 0.003 per cent recorded 30.91 per cent fruit infestation and both these treatments were at par with each

other. Similarly, azadirachtin (1%) @ 0.003 per cent and malathion 50 EC @ 0.05 per cent recorded 30.91 and 37.23 per cent fruit infestation, respectively and were also at par with each other. Further the treatment malathion 50 EC @ 0.05 per cent (37.23%) which was at par with deltamethrin

2.8 EC @ 0.0024 per cent and dichlorvos 76 EC @ 0.05 per cent recorded 40.57 and 42.38 per cent fruit infestation, respectively. The highest mean per cent fruit infestation was recorded in untreated control (69.82%).

Table 1: Efficacy of insecticides against fruit flies infesting cucumber after first spray

Sr. No.	Treatment	Conc. (%)	Per cent fruit infested					Cumulative per cent infestation
			Pre-count	3 DAS**	7 DAS	10 DAS	14 DAS	
1	Spinosad 45 SC	0.014	63.81 (53.08)*	21.50 (27.62)	15.38 (23.09)	18.61 (25.54)	21.41 (26.81)	19.23 (26.01)
2	Azadirachtin 1 %	0.003	52.42 (46.44)	31.95 (34.41)	28.60 (32.29)	30.77 (33.68)	32.33 (34.61)	30.91 (33.78)
3	Emamectin benzoate 5 SG	0.002	54.56 (47.60)	27.29 (31.40)	22.42 (28.09)	27.23 (31.45)	25.33 (30.19)	25.57 (30.38)
4	Malathion 50 EC	0.05	63.69 (53.67)	40.14 (39.31)	32.81 (34.90)	37.97 (38.04)	38.00 (38.04)	37.23 (37.60)
5	Dichlorvos 76 EC	0.05	59.33 (50.44)	44.46 (41.79)	37.78 (37.91)	43.60 (41.32)	43.67 (41.35)	42.38 (40.62)
6	Deltamethrin 2.8 EC	0.0024	60.00 (50.97)	40.86 (39.72)	37.22 (37.58)	42.54 (40.71)	41.67 (40.19)	40.57 (39.56)
7	Untreated control	-	66.22 (54.52)	68.88 (56.20)	66.40 (54.85)	72.67 (58.50)	71.33 (57.67)	69.82 (56.68)
S.Em. ±			5.78	1.49	2.49	0.84	1.25	1.51
CD (p=0.05)			NS	4.59	7.66	2.58	3.86	4.67

*Figures in parentheses are arcsine values

**DAS: Days after Spraying

2. Efficacy of insecticides against fruit flies infesting cucumber recorded at different intervals after second spray

The results on effect of second spray are presented in Table 2. The observations recorded on third day after second spray revealed that the per cent fruit infestation in the treatment with spinosad 45 SC @ 0.014 per cent was minimum (12.17%) and found significantly superior over rest of the treatments, followed by emamectin benzoate 5 SG @ 0.002 per cent which recorded 19.83 per cent fruit infestation, which was at par with azadirachtin (1%) @ 0.003 per cent (27.62%). Azadirachtin (1%) @ 0.003 per cent (27.62%) was also at par with malathion 50 EC @ 0.05 per cent (31.20%). Similarly, deltamethrin 2.8 EC @ 0.0024 per cent and dichlorvos 76 EC @ 0.05 per cent recorded 42.50 and 44.33 per cent fruit infestation, respectively and were also at par with each other. The maximum (74.33%) fruit infestation was recorded in untreated plot.

At seventh day of observation, the minimum (8.33%) fruit infestation was recorded in spinosad 45 SC @ 0.014 per cent which was significantly superior over rest of the treatments followed by emamectin benzoate 5 SG @ 0.002 per cent which recorded 13.33 per cent fruit infestation. The next best treatments were azadirachtin (1%) @ 0.003 per cent (20.67%) and malathion 50 EC @ 0.05 per cent (26.33%) which were at par with each other. Similarly, malathion 50 EC @ 0.05 per cent (26.33%) which was at par with deltamethrin 2.8 EC @ 0.0024 per cent and dichlorvos 76 EC @ 0.05 per cent recorded 31.30 and 32.33 per cent fruit infestation, respectively. Maximum (71.67%) fruit infestation was noticed in untreated plot.

The observations recorded on 10th day after second spray indicated that the treatment with spinosad 45 SC @ 0.014 per

cent was found to be most effective treatment which recorded 11.67 per cent fruit infestation and was at par with emamectin benzoate 5 SG @ 0.002 per cent (12.17%). The next best treatment was azadirachtin (1%) @ 0.003 per cent (21.30%) which was at par with the malathion 50 EC @ 0.05 per cent, deltamethrin 2.8 EC @ 0.0024 per cent and dichlorvos 76 EC @ 0.05 per cent recorded 24.43, 27.80 and 28.40 per cent fruit infestation, respectively. The highest (64.33%) fruit infestation was observed in untreated control.

On 14th day after second spray, the minimum fruit infestation was recorded in the treatment spinosad 45 SC @ 0.014 per cent and was found to be most effective treatment which recorded 14.00 per cent fruit infestation. It was at par emamectin benzoate 5 SG @ 0.002 per cent (16.33%). The next best treatment azadirachtin (1%) @ 0.003 per cent (30.67%) which was at par with the malathion 50 EC @ 0.05 per cent, deltamethrin 2.8 EC @ 0.0024 per cent and dichlorvos 76 EC @ 0.05 per cent recorded 32.23, 34.67 and 37.33 per cent fruit infestation, respectively. The maximum (74.67%) fruit infestation was observed in untreated plot.

The data on cumulative mean fruit infestation indicated that among the treatments, spinosad 45 SC @ 0.014 per cent recorded minimum (11.54%) fruit infestation and was at par emamectin benzoate 5 SG @ 0.002 per cent (15.42%). The next best treatments were azadirachtin (1%) @ 0.003 per cent (25.07%) and malathion 50 EC @ 0.05 per cent (28.55%) which were at par with each other. Malathion 50 EC @ 0.05 per cent (28.55%) was also at par with deltamethrin 2.8 EC @ 0.0024 per cent and dichlorvos 76 EC @ 0.05 per cent which recorded 34.06 and 35.60 per cent fruit infestation, respectively. The highest mean per cent fruit infestation was recorded in untreated control (71.25%).

Table 2: Efficacy of insecticides against fruit flies infesting cucumber after second spray

Sr. No.	Treatment	Conc. (%)	Per cent fruit infested					Cumulative per cent infestation
			Pre-count	3 DAS**	7 DAS	10 DAS	14 DAS	
1	Spinosad 45 SC	0.014	21.41(26.81)*	12.17(20.41)	8.33(16.74)	11.67(19.96)	14.00(21.80)	11.54 (19.86)
2	Azadirachtin 1 %	0.003	32.33(34.61)	27.62(31.58)	20.67(27.04)	21.30(27.43)	30.67(33.61)	25.07 (30.05)
3	Emamectin benzoate 5 SG	0.002	25.33(30.19)	19.83(26.33)	13.33(21.41)	12.17(20.40)	16.33(23.76)	15.42 (23.12)
4	Malathion 50 EC	0.05	38.00(38.04)	31.20(33.93)	26.33(30.87)	24.43(29.55)	32.23(34.69)	28.55 (32.30)
5	Dichlorvos 76 EC	0.05	43.67(41.35)	44.33(41.74)	32.33(34.64)	28.40(32.05)	37.33(37.63)	35.60 (36.63)
6	Deltamethrin 2.8 EC	0.0024	41.67(40.19)	42.50(40.60)	31.30(34.00)	27.80(31.80)	34.67(36.02)	34.06 (35.70)

7	Untreated control	-	71.33(57.67)	74.33(59.62)	71.67(57.98)	64.33(53.34)	74.67(59.87)	71.25 (57.58)
	S.Em. \pm		1.25	1.85	1.25	1.52	1.70	1.58
	CD (p=0.05)		3.86	5.69	3.85	4.69	5.25	4.87

*Figures in parentheses are arcsine values

**DAS: Days after Spraying

3. Cumulative efficacy of insecticides against fruit flies infesting cucumber

The data pertaining to the cumulative efficacy of insecticides against fruit flies infesting cucumber are presented in Table 3. The results regarding cumulative mean of two sprays revealed that spinosad 45 SC @ 0.014 per cent was the best treatment which recorded minimum (15.38%) mean fruit infestation and was at par with emamectin benzoate 5 SG @ 0.002 per cent (20.49%). The next best treatments were azadirachtin (1%) @ 0.003 per cent (27.99%) and malathion 50 EC @ 0.05 per cent (32.89%) which were at par with each other. Similarly, malathion 50 EC @ 0.05 per cent (32.89%) was at par with deltamethrin 2.8 EC @ 0.0024 per cent and dichlorvos 76 EC @ 0.05 per cent which recorded 37.32 and 38.99 per cent fruit infestation, respectively. All the above treatments were found to be superior over untreated control which recorded highest fruit infestation (70.54%).

The present findings are in agreement with Pawar *et al.* (1984) [5]. They evaluated six insecticides for the control of *B. cucurbitae* Coq. and recorded lowest infestation 15.59 per

cent in treatment with monocrotophos (0.05%) followed by 23.71er cent in carbaryl (0.5%) as compared to 70.24 per cent in control.

Ranganath *et al.* (1997) [7] tested a number of botanicals and chemical insecticides against *B. cucurbitae* on cucumber and reported that neem oil (1.2%) was the most effective in reducing the damage in cucumber and recorded 6.2 per cent infestation over 39.0 per cent in the control. Sawai (2013) [9] revealed that the treatment of deltamethrin (0.0016%) recorded significantly lowest (20.15%) fruit damage, however it was statistically at par with DDVP (0.05%), emamectin benzoate (0.0016%) and azadirachtin (0.0025%) with 22.83, 24.05 and 24.79 per cent fruit damage, respectively.

Panday *et al.* (2014) [4] reported that the spray of ethion + cypermethrin recorded minimum fruit damage (2.47%) followed by profenophos 50 EC (5.57%) and profenophos + cypermethrin (7.11%). The control plot exhibited maximum fruit damage (44.50%) followed by neemarin (13.92%) and endosulfan (9.04%).

Table 3: Cumulative efficacy of insecticides against fruit flies infesting cucumber

Sr. No.	Treatment	Conc. (%)	Per cent fruit infested		Cumulative per cent infestation
			First spray	Second spray	
1	Spinosad 45 SC	0.014	19.23(26.01)*	11.54(19.86)	15.38(23.09)
2	Azadirachtin 1 %	0.003	30.91(33.78)	25.07(30.05)	27.99(31.94)
3	Emamectin benzoate 5 SG	0.002	25.57(30.38)	15.42(23.12)	20.49(26.91)
4	Malathion 50 EC	0.05	37.23(37.60)	28.55(32.30)	32.89(34.99)
5	Dichlorvos 76 EC	0.05	42.38(40.62)	35.60(36.63)	38.99(38.64)
6	Deltamethrin 2.8 EC	0.0024	40.57(39.56)	34.06(35.70)	37.32(37.65)
7	Untreated control	-	69.82(56.68)	71.25(57.58)	70.54(57.17)
	S.Em. \pm		1.51	1.58	1.55
	CD (p=0.05)		4.67	4.87	4.77

*Figures in parentheses are arcsine value

Conclusion

From the present study, it can be concluded that the efficacy of insecticides on the basis of cumulative per cent infestation of fruit flies infesting cucumber in both sprays indicated that spinosad 45 SC @ 0.014 per cent was the best treatment which recorded minimum (15.38%) mean fruit infestation and was at par with emamectin benzoate 5 SG @ 0.002 per cent (20.49%). The next best treatments were azadirachtin (1%) @ 0.003 per cent (27.99%) and malathion 50 EC @ 0.05 per cent (32.89%) which were at par with each other.

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