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Evaluation of insecticides in the management of fruit flies infesting ridge gourd

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Abstract

The field experiment was carried out on evaluation of insecticides in the management of fruit flies infesting ridge gourd during *kharif* season of 2017 at Central Experimental Station, Wakawali, Dist-Ratnagiri. During this study evaluate six insecticides *viz.*, spinosad 45 SC @ 0.014, emamectin benzoate 5 SG @ 0.002, deltamethrin 2.8 EC @ 0.0024, azadirachtin (1%) @ 0.003, dichlorvos 76 EC @ 0.05 and malathion 50 EC @ 0.05 percent respectively. The results regarding overall mean of three sprays on the efficacy of insecticides indicated that spinosad 45 SC @ 0.014 percent was the best treatment which recorded minimum (23.55%) mean fruit infestation and was at par with emamectin benzoate 5 SG @ 0.002 percent (24.77%) and deltamethrin 2.8 EC @ 0.0024 percent (25.93%). All the above treatments were found to be superior over untreated control which recorded highest (47.19%) fruit infestation.

Keywords: Efficacy, fruit flies, ridge gourd, insecticides, *Batocera* spp

Introduction

Ridge gourd (*Luffa acutangula* L.) is considered to be old species with its native to the tropical Africa and South East Asian region including India. It is widely grown in tropical and subtropical parts of the country. It belongs to family Cucurbitaceae and genus *Luffa*. It is one of the important crops belonging to cucurbits and locally called as *Shiral*, *Dodka* (Marathi), *Turai* (Gujrat) and *Koshataki* (Sanskrit).

India is the second largest producer of vegetables in the world, after china, by producing around 175 million tonnes vegetables annually from an area of around 10 million hectors (Anon., 2017) [2]. Ridge gourd is cultivated in approximately 24,800 acres in India with total production about 3,16,925 tonnes (Anon., 2015) [1]. Maharashtra produced vegetables with annual production of 103.60 lakh tonnes from an area of 6.93 lakh ha (Anon., 2017) [2].

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 (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) [3]. The extent of loss inflicted by fruit flies is varying from 30 to 100 percent depending upon cucurbit species and environmental condition (Dhillon *et al.*, 2005) [4]. 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) [7]. Though a number of insecticides have been reported to be effective against this pest but the information on ridge gourd in Konkan 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 100:50:50 N:P:K kg ha⁻¹. Nitrogen @ 100 kg ha⁻¹ was applied in three splits doses viz., first dose of 33 kg ha⁻¹ N at the time of sowing, second dose of 34 kg ha⁻¹ N after 30 days of sowing and remaining 33 kg ha⁻¹ dose of N after 60 days of sowing. Phosphorus was applied @ 50 kg ha⁻¹ and potassium was applied @ 50 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 ridge gourd (cv. Konkan Harita) in each plot. The other agronomic operations viz., intercultural operations and weeding were done as per recommendation.

Details of the field experiment

1	Cultivar	:	Konkan Harita
2	Spacing	:	1.50 m × 0.50 m
3	Total plot size	:	189.00 m ²
4	Date of sowing	:	12 th 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
Treatment Details			
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 thrice. First spray of each insecticide was applied when incidence was noticed on fruits, while the second and third 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 and second spray were considered as pre-count observation of second and third spray. The percent 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.

No. of infested fruits

Percent 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 ridge gourd

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

Data pertaining to the efficacy of some insecticides against fruit flies infesting ridge gourd are given in Table 1.

The infestation of the fruit flies prior to application of insecticides ranged from 31.32 to 37.33 percent. 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 emamectin benzoate 5 SG @ 0.002 percent was found to be most effective treatment with 28.62 percent fruit infestation which was at par with spinosad 45 SC @ 0.014 percent (29.33%), deltamethrin 2.8 EC @ 0.0024 percent (30.17%) malathion 50 EC @ 0.05 percent (31.98%) and azadirachtin (1%) @ 0.003 percent (33.97%), respectively. The treatment spinosad 45 SC @ 0.014 percent (29.33%) was at par with the treatments deltamethrin 2.8 EC @ 0.0024 percent (30.17%), malathion 50 EC @ 0.05 percent (31.98%), azadirachtin (1%) @ 0.003 percent (33.97%) and dichlorvos 76 EC @ 0.05 percent (34.90%). The maximum (38.65%) fruit infestation was noticed in untreated control.

On the seventh day after spraying the minimum (23.99%) fruit infestation was observed in treatment spinosad 45 SC @ 0.014 percent and was at par with deltamethrin 2.8 EC @ 0.0024 and emamectin benzoate 5 SG @ 0.002 percent which recorded 25.85 and 26.16 percent fruit infestation, respectively. The treatments deltamethrin 2.8 EC @ 0.0024 (25.85%), emamectin benzoate 5 SG @ 0.002 percent (26.16%), azadirachtin 1% @ 0.003 percent (28.33%) and malathion 50 EC @ 0.05 percent recorded 28.43 percent fruit infestation and were at par with each other. Dichlorvos 76 EC @ 0.05 percent recorded 33.10 percent fruit infestation. The maximum (44.65%) fruit infestation was found in untreated plot.

On 10th day after first spray, the minimum (26.82%) fruit infestation was recorded in the treatment spinosad 45 SC @ 0.014 percent which was at par with emamectin benzoate 5 SG @ 0.002 percent (27.13%), deltamethrin 2.8 EC @ 0.0024 percent (28.10%) and malathion 50 EC @ 0.05 percent (28.19%), respectively. While, the treatments deltamethrin 2.8 EC @ 0.0024 percent (28.10%), malathion 50 EC @ 0.05 percent (28.19%) and azadirachtin (1%) @ 0.003 percent (32.00%) were at par with each other. Dichlorvos 76 EC @ 0.05 percent recorded 39.55 percent fruit infestation.

The maximum (45.31%) fruit infestation was observed in untreated control. At 14th day of observation, the minimum (29.15%) fruit infestation was recorded in emamectin benzoate 5 SG @ 0.002 percent and was at par with treatments, spinosad 45 SC @ 0.014 percent and deltamethrin 2.8 EC @ 0.0024 percent which recorded 31.33 and 31.66 percent fruit infestation, respectively. While, the treatments spinosad 45 SC @ 0.014 percent (31.33%), deltamethrin 2.8 EC @ 0.0024 percent (31.66%) azadirachtin (1%) @ 0.003 percent (32.98%) and malathion 50 EC @ 0.05 percent (33.51%) were at par with each other, followed by dichlorvos 76 EC @ 0.05 percent which recorded 38.65 percent fruit infestation, while the maximum (48.32%) fruit infestation was observed in untreated control.

The results of overall mean percent mean infestation revealed that the treatment emamectin benzoate 5 SG @ 0.002 percent was found to be the most effective treatment which recorded 27.75 percent fruit infestation and was at par with the treatments spinosad 45 SC @ 0.014 percent, deltamethrin 2.8 EC @ 0.0024, malathion 50 EC @ 0.05 percent and azadirachtin (1%) @ 0.003 percent which recorded 27.83 percent 28.92 percent, 30.51 percent and 31.84 percent fruit infestation, respectively. It was followed by dichlorvos 76 EC @ 0.05 percent which recorded 36.54 percent fruit infestation, while the maximum (44.22%) percent fruit infestation was observed in untreated control.

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

Sr. No.	Treatment	Conc. (%)	Percent fruit infested					Overall mean percent infestation
			Pre-count	3 DAS**	7 DAS	10 DAS	14 DAS	
1	Spinosad 45 SC	0.014	35.67 (36.67)*	29.33 (32.79)	23.99 (29.33)	26.82 (31.19)	31.33 (34.04)	27.83 (31.84)
2	Azadirachtin 1%	0.003	34.65 (36.06)	33.97 (35.65)	28.33 (32.16)	32.20 (34.55)	32.98 (35.05)	31.84 (34.35)
3	Emamectin benzoate 5 SG	0.002	31.32 (34.03)	28.62 (32.34)	26.16 (30.76)	27.13 (31.39)	29.15 (32.68)	27.75 (31.79)
4	Malathion 50 EC	0.05	36.10 (36.93)	31.98 (34.44)	28.43 (32.22)	28.19 (32.07)	33.51 (35.37)	30.51 (33.53)
5	Dichlorvos 76 EC	0.05	35.10 (36.33)	34.90 (36.21)	33.10 (35.12)	39.55 (38.97)	38.65 (38.44)	36.54 (37.19)
6	Deltamethrin 2.8 EC	0.0024	36.65 (37.26)	30.17 (33.32)	25.85 (30.56)	28.10 (32.01)	31.66 (34.24)	28.92 (32.53)
7	Untreated Control	-	37.33 (37.66)	38.65 (38.44)	44.65 (41.93)	45.31 (42.31)	48.32 (44.04)	44.22 (41.68)
	S.Em.±		0.86	1.24	0.71	1.01	0.70	0.92
	CD (p = 0.05)		NS	3.81	2.19	3.10	2.15	2.81

*Figures in parentheses are arcsine values

**DAS: Days After Spraying

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

Data on percent fruit infestation of fruit flies recorded at 3, 7, 10 and 14 days after second spray are presented in Table 2.

The observations recorded on third day after second spray revealed that the percent fruit infestation in the treatment spinosad 45 SC @ 0.014 percent was minimum (28.40%) and was at par with emamectin benzoate 5 SG @ 0.002 percent, deltamethrin 2.8 EC @ 0.0024 percent and Azadirachtin (1%) @ 0.003 percent which recorded 29.00 percent, 30.24 percent and 31.33 percent fruit infestation, respectively. Similarly, the treatment emamectin benzoate 5 SG @ 0.002 percent which recorded 29.00 percent fruit infestation, and was at par with deltamethrin 2.8 EC @ 0.0024 percent (30.24%), azadirachtin (1%) @ 0.003 percent (31.33%) and malathion 50 EC @ 0.05 percent (32.00%), respectively. The treatment dichlorvos 76 EC @ 0.05 percent recorded 38.16 percent fruit infestation while, the maximum (47.33%) fruit infestation was recorded in untreated plot.

At seventh day of observation, the minimum (23.33%) fruit infestation was recorded in spinosad 45 SC @ 0.014 percent which was at par with emamectin benzoate 5 SG @ 0.002 percent, deltamethrin 2.8 EC @ 0.0024 percent, malathion 50 EC @ 0.05 percent and azadirachtin (1%) @ 0.003 percent with 25.47, 25.50, 28.30 and 29.15 percent fruit infestation, respectively. While, treatments malathion 50 EC @ 0.05 percent (28.30%), azadirachtin (1%) @ 0.003 percent (29.15%) and dichlorvos 76 EC @ 0.05 percent (33.26%) were at par with each other. Maximum (47.64%) 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 percent was found to be most effective treatment which recorded 25.801 percent fruit infestation and was at par with deltamethrin 2.8 EC @ 0.0024 percent, emamectin benzoate 5

SG @ 0.002 percent, malathion 50 EC @ 0.05 percent, and azadirachtin (1%) @ 0.003 percent with 27.13, 27.47, 29.82 and 31.98 percent fruit infestation, respectively. Further, the treatments malathion 50 EC @ 0.05 percent, azadirachtin (1%) @ 0.003 percent and dichlorvos 76 EC @ 0.05 percent recorded 29.82, 31.98 and 35.98 percent fruit infestation, respectively were at par with each other. The highest (51.17%) fruit infestation was observed in untreated control.

At 14th day of observation, the treatments spinosad 45 SC @ 0.014 percent, emamectin benzoate 5 SG @ 0.002 percent and deltamethrin 2.8 EC @ 0.0024 percent recorded 23.39, 24.58 and 24.80 percent fruit infestation, respectively and were at par with each other. Similarly, treatments malathion 50 EC @ 0.05 percent, azadirachtin (1%) @ 0.003 percent and dichlorvos 76 EC @ 0.05 percent were at par with each other with 29.70, 30.11 and 32.69 percent infestation, respectively. The highest (44.34%) fruit infestation was recorded in untreated control.

The data on overall mean percent infestation indicated that among the all treatments, spinosad 45 SC @ 0.014 percent recorded minimum (25.20%) fruit infestation and was at par with emamectin benzoate 5 SG @ 0.002 percent (26.62%), deltamethrin 2.8 EC @ 0.0024 percent (26.90%) and malathion 50 EC @ 0.05 percent (29.95%). The next best treatment was emamectin benzoate 5 SG @ 0.002 percent with 26.62 percent fruit infestation and was at par with deltamethrin 2.8 EC @ 0.0024 percent, malathion 50 EC @ 0.05 percent and azadirachtin (1%) @ 0.003 percent which recorded 26.90, 29.95 and 30.64 percent fruit infestation, respectively. The treatments malathion 50 EC @ 0.05 percent azadirachtin (1%) @ 0.003 percent and dichlorvos 76 EC @ 0.05 percent recorded 29.95, 30.64 and 35.01 percent fruit infestation, respectively and were at par with each other. The highest mean percent fruit infestation was recorded in untreated control (47.63%).

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

Sr. No.	Treatment	Conc. (%)	Percent fruit infested					Overall mean percent infestation
			Pre-count	3 DAS**	7 DAS	10 DAS	14 DAS	
1	Spinosad 45 SC	0.014	31.33 (34.04)*	28.40 (32.20)	23.33 (28.88)	25.81 (30.53)	23.39 (28.92)	25.20 (30.13)
2	Azadirachtin 1%	0.003	32.98 (35.05)	31.33 (34.04)	29.15 (32.68)	31.98 (34.44)	30.11 (33.28)	30.64 (33.61)
3	Emamectin benzoate 5 SG	0.002	29.15 (32.68)	29.00 (32.58)	25.47 (30.31)	27.47 (31.61)	24.58 (29.72)	26.62 (31.06)
4	Malathion 50 EC	0.05	33.51 (35.37)	32.00 (34.45)	28.30 (32.14)	29.82 (33.10)	29.70 (33.02)	29.95 (33.18)
5	Dichlorvos 76 EC	0.05	38.65 (38.44)	38.16 (38.15)	33.26 (35.22)	35.98 (36.86)	32.69 (34.87)	35.01 (36.28)
6	Deltamethrin 2.8 EC	0.0024	31.66 (34.24)	30.24 (33.36)	25.50 (30.33)	27.13 (31.39)	24.80 (29.87)	26.90 (31.24)
7	Untreated Control	-	48.32 (44.04)	47.33 (43.47)	47.64 (43.65)	51.17 (45.67)	44.34 (41.75)	47.63 (43.64)
	S.Em.±		0.70	0.61	1.53	1.27	0.87	1.07
	CD (p = 0.05)		2.15	1.89	4.72	3.92	2.69	3.31

*Figures in parentheses are arcsine values

**DAS: Days After Spraying

3. Efficacy of some insecticides against fruit flies infesting ridge gourd recorded at different intervals after third spray

The results on effect of third spray are presented in Table 3. The observations recorded on third day after third spray revealed that the percent fruit infestation in the treatment spinosad 45 SC @ 0.014 percent was minimum (21.67%). The treatments spinosad 45 SC @ 0.014 percent, emamectin benzoate 5 SG @ 0.002 percent and deltamethrin 2.8 EC @ 0.0024 percent recorded 21.67, 23.46 and 23.77 percent fruit infestation, respectively and were at par with each other. Similarly, treatments malathion 50 EC @ 0.05 percent (28.65%), azadirachtin (1%) @ 0.003 percent (29.82%) and dichlorvos 76 EC @ 0.05 percent (31.33%) were at par with each other. The maximum (46.67%) fruit infestation was recorded in untreated plot.

At seventh day of observation, the minimum (18.60%) fruit infestation was recorded in spinosad 45 SC @ 0.014 percent which was at par with emamectin benzoate 5 SG @ 0.002 percent and deltamethrin 2.8 EC @ 0.0024 percent with 21.19 and 23.11 percent fruit infestation, respectively. Further the treatment deltamethrin 2.8 EC @ 0.0024 percent (23.11%) was at par with treatments malathion 50 EC @ 0.05 percent and azadirachtin (1%) @ 0.003 percent which recorded 27.46 and 28.38 percent fruit infestation, respectively. While, treatments malathion 50 EC @ 0.05 percent (27.46%), azadirachtin (1%) @ 0.003 percent (28.38%) and dichlorvos 76 EC @ 0.05 percent (30.32%) were at par with each other. Maximum (48.66%) fruit infestation was noticed in untreated plot.

The observations recorded on 10th day after third spray indicated that the treatment with spinosad 45 SC @ 0.014 percent was found to be most effective treatment with 16.73 percent fruit infestation which was at par with emamectin benzoate 5 SG @ 0.002 percent and deltamethrin 2.8 EC @

0.0024 percent with 19.33 and 21.11 percent fruit infestation, respectively. The treatment emamectin benzoate 5 SG @ 0.002 percent (19.33%) was at par with deltamethrin 2.8 EC @ 0.0024 percent (21.11%) and malathion 50 EC @ 0.05 percent (25.59%). Treatments malathion 50 EC @ 0.05 percent, azadirachtin (1%) @ 0.003 percent and dichlorvos 76 EC @ 0.05 percent recorded 25.39, 27.86 and 28.00 percent fruit infestation, and were at par with each other. The highest (50.40%) fruit infestation was observed in untreated control.

At 14th day of observation, after third spray the treatment spinosad 45 SC @ 0.014 percent was found to be most effective treatment which recorded 15.33 percent fruit infestation and was at par with treatments emamectin benzoate 5 SG @ 0.002 percent and deltamethrin 2.8 EC @ 0.0024 percent with 17.05 and 20.61 percent fruit infestation, respectively. While the treatments deltamethrin 2.8 EC @ 0.0024 percent (20.61%), malathion 50 EC @ 0.05 percent (24.07%), azadirachtin (1%) @ 0.003 percent (25.11%) and dichlorvos 76 EC @ 0.05 percent (26.42%) were at par with each other. The highest (53.33%) fruit infestation was recorded in untreated control.

The data on overall mean percent infestation indicated that among all the treatments, spinosad 45 SC @ 0.014 percent recorded minimum (18.02%) fruit infestation and was at par with emamectin benzoate 5 SG @ 0.002 percent (20.20%), and deltamethrin 2.8 EC @ 0.0024 percent (22.14%). Treatments deltamethrin 2.8 EC @ 0.0024 percent recorded 22.14 percent fruit infestation and was at par with malathion 50 EC @ 0.05 percent and azadirachtin (1%) @ 0.003 percent which recorded 26.37, and 27.78 percent fruit infestation, respectively. Treatments malathion 50 EC @ 0.05 percent (26.37%), azadirachtin (1%) @ 0.003 percent (27.78) and dichlorvos 76 EC @ 0.05 percent (29.00%) were at par with each other. The highest mean percent fruit infestation was recorded in untreated control (49.77%).

Table 3: Efficacy of insecticides against fruit flies infesting ridge gourd after third spray

Sr. No.	Treatment	Conc. (%)	Percent fruit infested					Overall mean percent infestation
			Pre-count	3 DAS**	7 DAS	10 DAS	14 DAS	
1	Spinosad 45 SC	0.014	23.39 (28.92)*	21.67 (27.74)	18.60 (25.55)	16.73 (24.14)	15.33 (23.05)	18.02 (25.12)
2	Azadirachtin 1%	0.003	30.11 (33.28)	29.82 (33.10)	28.38 (32.19)	27.86 (31.86)	25.11 (30.07)	27.78 (31.81)
3	Emamectin benzoate 5 SG	0.002	24.58 (29.72)	23.46 (28.97)	21.19 (27.41)	19.33 (26.08)	17.05 (24.39)	20.20 (26.71)
4	Malathion 50 EC	0.05	29.70 (33.02)	28.65 (32.36)	27.46 (31.60)	25.39 (30.26)	24.07 (29.38)	26.37 (30.90)
5	Dichlorvos 76 EC	0.05	32.69 (34.87)	31.33 (34.04)	30.32 (33.41)	28.00 (31.95)	26.42 (30.93)	29.00 (32.58)
6	Deltamethrin 2.8 EC	0.0024	24.80 (29.87)	23.77 (29.18)	23.11 (28.73)	21.11 (27.35)	20.61 (27.00)	22.14 (28.07)
7	Untreated Control	-	44.34 (41.75)	46.67 (43.09)	48.66 (44.23)	50.40 (45.23)	53.33 (46.91)	49.77 (44.87)
	S.Em.±		0.87	0.95	1.13	1.42	1.40	1.23
	CD (p = 0.05)		2.69	2.92	3.49	4.37	4.31	3.77

*Figures in parentheses are arcsine values

**DAS: Days After Spraying

4. Cumulative efficacy of different insecticides against fruit flies infesting ridge gourd

The data pertaining to the cumulative efficacy of different insecticides against fruit flies infesting ridge gourd are presented in Table 4.

The results regarding overall mean of three sprays revealed that spinosad 45 SC @ 0.014 percent was the best treatment which recorded minimum (23.55%) mean fruit infestation and was at par with emamectin benzoate 5 SG @ 0.002 percent (24.77%) and deltamethrin 2.8 EC @ 0.0024 percent (25.93%). Similarly, treatment emamectin benzoate 5 SG @ 0.002 percent (24.77%) was at par with deltamethrin 2.8 EC @ 0.0024 percent and malathion 50 EC @ 0.05 percent which recorded 25.93 and 28.92 percent fruit infestation,

respectively. Further treatment deltamethrin 2.8 EC @ 0.0024 percent (25.93%) was at par with malathion 50 EC @ 0.05 percent (28.92%) and azadirachtin (1%) @ 0.003 percent (30.08%). While treatments malathion 50 EC @ 0.05 percent (28.92%), azadirachtin (1%) @ 0.003 percent (30.08%) and dichlorvos 76 EC @ 0.05 percent (33.47%) were at par with each other. All the above treatments were found to be superior over untreated control which recorded highest fruit infestation (47.19%).

The present findings are more or less in conformity with the results of Khan and Khattak (2000) [5] carried out three sprays of dipterex and malathion @ 1.0 percent on muskmelon and noticed that the fruit fly infestation reduced to the extent of 21.67 and 26.00 percent, respectively.

Similarly, Sawai (2013) [8] revealed that the treatment deltamethrin 0.0025 percent was effective (20.15%) in reducing the fruit damage however, it was statistically at par with DDVP 0.05 percent (22.83%), emamectin benzoate 0.0016 percent (24.05%) and azadirachtin 0.0025 percent (24.79%). In remaining treatments the order of efficacy was, spinosad (0.016%) > malathion (0.05%) > carbaryl (0.1%) > control with 25.44, 26.84, 27.72 and 44.95 percent fruit damage, respectively.

Further the present results are in accordance with Sunil (2015) [9]. He revealed that the lowest infestation (13.15%) was recorded in deltamethrin + jaggery @ 0.0028 + 0.015 percent which was significantly superior over rest of the treatments. This was followed by deltamethrin @ 0.0028 percent (22.49%), azadirachtin @ 0.005percent (22.91%), malathion @ 0.1 percent (24.00%), spinosad @ 0.014 percent (28.71%) and dichlorvos @ 0.152 percent (31.11%) which were on par. The highest fruit infestation was observed in untreated control (40.63%).

Table 4: Cumulative efficacy of different insecticides against fruit flies infesting ridge gourd.

Sr. No.	Treatment	Conc. (%)	Mean percent fruit infested			Cumulative percent infestation
			First spray	Second spray	Third spray	
1	Spinosad 45 SC	0.014	27.87 (31.84)*	25.20 (30.13)	18.02 (25.12)	23.55 (29.03)
2	Azadirachtin 1%	0.003	31.84 (34.35)	30.64 (33.61)	27.78 (31.81)	30.08 (33.26)
3	Emamectin benzoate 5 SG	0.002	27.75 (31.79)	26.62 (31.06)	20.20 (26.71)	24.77 (29.85)
4	Malathion 50 EC	0.05	30.51 (33.53)	29.95 (33.18)	26.37 (30.90)	28.92 (32.53)
5	Dichlorvos 76 EC	0.05	36.54 (37.19)	35.01 (36.28)	29.00 (32.58)	33.47 (35.35)
6	Deltamethrin 2.8 EC	0.024	28.92 (32.53)	26.90 (31.24)	22.14 (28.07)	25.93 (30.61)
7	Untreated Control	-	44.22 (41.68)	47.63 (43.64)	49.77 (44.87)	47.19 (43.39)
S.Em.±			0.92	1.07	1.23	1.07
CD (p = 0.05)			2.81	3.31	3.77	3.30

*Figures in parentheses are arcsine values.

Conclusion

From the present study, it can be concluded that the efficacy of insecticides on the basis of overall mean of three sprays against fruit flies infesting ridge gourd were found to be treatments spinosad 45 SC @ 0.014 percent was the best treatment which recorded minimum (23.55%) mean fruit infestation and was at par with emamectin benzoate 5 SG @ 0.002 percent (24.77%) and deltamethrin 2.8 EC @ 0.0024 percent (25.93%). All the above treatments were found to be superior over untreated control which recorded highest (47.19%) fruit infestation.

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