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PM Maligimani
M.Sc. Scholar, Department of Entomology, PGI, MPKV, Rahuri, Maharashtra, India

YS Saindane
Assistant residue Analyst, AINP on Pesticide Residues, Department of Entomology, PGI, MPKV, Rahuri, Maharashtra, India

BV Deore
Residue Analyst, AINP on Pesticide Residues, Department of Entomology, PGI, MPKV, Rahuri, Maharashtra, India

CS Patil
Head, Department of Entomology, PGI, MPKV, Rahuri, Maharashtra, India

Corresponding Author:
PM Maligimani
M.Sc. Scholar, Department of Entomology, PGI, MPKV, Rahuri, Maharashtra, India

Bioefficacy of some newer insecticides against major insect pests of cucumber (*Cucumis sativus* L.)

PM Maligimani, YS Saindane, BV Deore and CS Patil

Abstract
Present research entitled "Bioefficacy of some newer insecticides against major insect pests of cucumber (*Cucumis sativus* L.)" was conducted during *rabi*-2022-23 at Research Farm, Post Graduate Institute, MPKV, Rahuri and comprised nine treatments *viz*, T_1- Lamda cyhalothrin 5% EC, T_2- Acephate 75% SP, T_3- Fipronil 5% SC, T_4- Chlorantraniliprole 18.5% SC, T_5- Spinosad 45% SC, T_6- Imidacloprid 70%WG, T_7- Spiromesifen 22.9% SC, T_8- Azadirachtin 1500 ppm and T_9- Untreated control conducted out in RBD with three replications. Among the treatments Spinosad 45% SC recorded the lowest percent leaf infestation due to leaf miner (13.76%), imidacloprid 70% WG recorded lowest number of aphids (17.84/per three leaves of a plant), lamda cyhalothrin% EC recorded lowest percent fruit infestation (14.44%) due to fruit fly and chlorantraniliprole 18.5% SC recorded lowest number of red pumpkin beetles (2.62 beetles/plant).

Keywords: Cucumber, fruit fly, leaf miner, aphid, red pumpkin beetle

Introduction
Cucumber (*Cucumis sativus* L.) belongs to family cucurbitaceae one of the most popular vegetable crop grown in different parts of the world. Cucumber is a hot season crop but it also can be grown in topical, subtropical and temperate regions with temperature ranging from 26 to 35 °C, In India, area under cucumber cultivation is 1,21,000 ha with production of 16,43,000 MT (Anonymous., 2022-23) [1]. Nutritively 100 g of edible portion of cucumber contains 96.3 g moisture, 2.5 g carbohydrates, 0.4 g protein, 0.1 g fat, 0.3 g minerals, 10 mg calcium, 0.4 g fiber and traces of vitamin C and iron. The pests such as fruitfly, red pumpkin beetle, leaf miner and aphids are serious problems of cucumber crop in field condition. Insecticide application is one of the management options that can substantially reduce yield losses caused by these insect pests. Bio-efficacy of pesticides needs to be studied for formulating effective and economical management strategies of insect pests.

Materials and Methods
The investigation was conducted during *rabi* season of 2022-23 at Research Farm, Post Graduate Institute, MPKV, Rahuri. The field trial was laid down in randomized block design (RBD) with 3 replications and 9 treatments *viz.* T_1- Lamda cyhalothrin 5% EC, T_2- Acephate 75% SP, T_3- Fipronil 5% SC, T_4- Chlorantraniliprole 18.5% SC, T_5- Spinosad 45% SC, T_6- Imidacloprid 70%WG, T_7- Spiromesifen 22.9% SC, T_8- Azadirachtin 1500 ppm and T_9- Untreated control, Cucumber variety Gypsy + was sown in a plot size of (3m x 3m) at a spacing of (100 x 30 cm). Insecticides of different chemical groups were selected and the treatments were imposed as foliar sprays against the major cucumber pests. Total two sprays were given at an interval of 10 days, initiating the first spray at fruit initiation stage. Quantity of spray fluid required per plot was calculated by spraying untreated control plot with water, taking into consideration the recommended rate of 500 lit/ha

1. Leaf miner
Observations on percent damaged leaves were recorded on five tagged plants in each plot. The observations were recorded by counting total number of leaves per plant and number of leaf miner infested leaves. Pre treatment count of *Liriomyza. trifolii* damage was recorded on 1 day before the insecticide application and subsequent observations for post treatment counts were recorded 1, 5 and 10 days after insecticide application. The percent damage was expressed as below. Kale *et al.* (2022) [2].

$$\text{Percent damage of leaves} = \frac{\text{Number of leaf miner infested leaves}}{\text{Total number of leaves}} \text{ X } 100$$

2. Aphid

Observations on aphid counts were recorded on five tagged plants in each plot. Aphid counts in cucumber crop were recorded from three leaves (one each from top, middle, and bottom strata) in a plant. Pre treatment count of *Aphis gossypi* was recorded on 1 day before the insecticide application and subsequent observations for post treatment counts were recorded 1, 5 and 10 days after insecticide application. Kaur *et al.* (2010) [3].

3. Fruit fly

Observations on percent damaged fruits were recorded on five tagged plants in each plot. The observations were recorded by number of damaged fruits and total number of healthy fruits. Pre treatment count of *Bactrocera cucurbitae* damage was recorded on 1 day before the insecticide application and subsequent observations for post treatment counts were recorded 3, 5 and 10 days after insecticide application. The percent fruit damage was expressed as below. Shinde *et al.* (2018) [4].

$$\text{Mean fruit damage (\%)} = \frac{\text{Number of damaged fruits}}{\text{Total number of fruits}} \text{ X } 100$$

4. Red Pumpkin beetle

Adults of red pumpkin beetle were counted from top, middle, and bottom leaves from five tagged plants in each plot. Pre treatment count of red pumpkin beetle was recorded on 1 day before the insecticide application and subsequent observations for post treatment counts were recorded 1, 5 and 10 days after insecticide application. Saljoqi and Khan (2007) [5].

Results and Discussion

Leaf miner

The data on the mean percent leaf infestation (1st, 5th & 10th day) after first spray showed that *Liriomyza trifoli* infestation levels varied among the various insecticidal treatments compared to untreated control (35.42%), with spinosad 45% SC recording the lowest percent infestation (15.08%) which was at par with chlorantraniliprole 18.5% SC (16.58%). Lamda cyhalothrin 5% EC (20.50%), fipronil 5% SC (24.82%) and acephate 75% SP (27.39%) were next in terms of effectiveness. Azadirachtin 1500 ppm (30.27%), imidacloprid 70% WG (31.37%), and spiromesifen 22.9% SC (32.87%) were less effective treatments, while spiromesifen 22.9% SC being the least effective treatment.

The data on the mean percent leaf infestation (1st, 5th & 10th day) after second spray revealed all insecticidal treatments significantly reduced the percentages of leaf infestation when compared to the control (35.62%). The different insecticidal treatments had different amounts of *Liriomyza trifoli* infestation; spinosad 45% SC recorded the lowest percent infestation (12.45%), followed by chlorantraniliprole 18.5% SC (13.54%) and lamda cyhalothrin 5% EC (15.39%). Acephate 75% SP (20.31%) was less effective than fipronil 5% SC (18.34%). The next effective treatments were azadirachtin 1500 ppm (23.03%), imidacloprid 70% WG (25.24%), and spiromesifen 22.9% SC (26.83%) while spiromesifen 22.9% SC being the least effective.

The mean data of two sprays revealed that, all the insecticidal treatments significantly reduced the percentages of leaf infestation when compared to the control (35.52%). Spinosad 45% SC recorded the lowest percent infestation (13.76%) which was at par with chlorantraniliprole 18.5% SC (14.56%) followed by lamda cyhalothrin 5% EC (17.94%). Acephate 75% SP (23.85%) and fipronil 5% SC (21.58%) were moderately effective. The other treatments *viz.*, azadirachtin 1500 ppm (26.65%), imidacloprid (28.30%), and spiromesifen 22.9% SC (29.85%) were less effective. Spiromesifen 22.9% SC was the least effective treatment with maximum percent leaf infestation.

The results of present investigation are in close agreement with result of Hirekurubar and Tatagar (2018) [6] who found that spinosad 45% SC was most effective in reducing leaf miner followed by chlorantraniliprole 18.5% SC.

Aphid

The mean data of aphid population (1st, 5th & 10th day) after first spray showed that all treatments significantly reduced the number of aphids relative to the control (60.19 per three leaves). Imidacloprid 70% WG (23.04 per three leaves) proved to be the superior treatment in controlling aphid which was at par with spiromesifen 22.9% SC (24.73 per three leaves). Acephate 75% SP (28.82 per three leaves) was at par with chlorantraniliprole 18.5% SC (30.54 per three leaves). The next effective treatments were fipronil 5% SC (35.17 per three leaves), spinosad 45% SC (38.36 per three leaves), lamda cyhalothrin 5% EC (42.60 per three leaves) and azadirachtin 1500 ppm (46.61 per three leaves), among these treatments azadirachtin 1500 ppm was found to be the least effective treatment.

The mean data of aphid population (1st, 5th & 10th day) after second spray showed that all treatments significantly reduced the number of aphids relative to the control (60.19 per three leaves). Imidacloprid 70% WG (23.04 per three leaves) proved to be the superior treatment in controlling aphid which was at par with spiromesifen 22.9% SC (24.73 per three leaves). Acephate 75% SP (28.82 per three leaves) was at par with chlorantraniliprole 18.5% SC (30.54 per three leaves). The next effective treatments were fipronil 5% SC (35.17 per three leaves), spinosad 45% SC (38.36 per three leaves), lamda cyhalothrin 5% EC (42.60 per three leaves) and azadirachtin 1500 ppm (46.61 per three leaves), among these treatments azadirachtin 1500 ppm was found to be the least effective treatment.

Cumulative mean of two sprays shown that all treatments greatly decreased the aphid population in comparison to the control (60.77 per three leaves). Imidacloprid 70% WG (12.64 per three leaves) proved to be the superior treatment in controlling aphid which was at par with spiromesifen 22.9% SC (13.72 per three leaves). Acephate 75% SP (17.76 per three leaves) was at par with chlorantraniliprole 18.5% SC (19.74 per three leaves). The next effective treatments were fipronil 5% SC (24.09 per three leaves), spinosad 45% SC (27.98 per three leaves), lamda cyhalothrin 5% EC (31.58 per three leaves) and azadirachtin 1500 ppm (35.91 per three leaves). Among these treatments azadirachtin 1500 ppm was found to be the least effective treatment.

The present findings are in accordance with the Pavan *et al.* (2019) [9] who reported that imidacloprid 70% WG was most effective treatment in controlling aphids. Ghosal *et al.* (2013) [10] recorded that imidacloprid 70% WG reduced the aphid population efficiently and found to be superior over other

treatments which is confirmatory to present results.

Fruit fly

The data on mean percent fruit infestation (3rd, 5th and 10th day) after first spray showed that all insecticidal treatments significantly reduced the percent fruit infestation compared to control (45.11%). The most efficient treatment, with a percent fruit infestation of 16.40%, was determined to be lamda cyhalothrin 5% EC followed by spinosad 45% SC (21.21%) and chlorantraniliprole 18.5% SC (21.68%). Azadirachtin 1500 ppm (27.09%) and acephate 75% SP (29.31%) were on par and fipronil 5% SC (34.23%) was the next most effective treatment. Imidacloprid 70% WG (39.10%) and spiromesifen 22.9% SC (44.37%) were found to be less effective than the other treatments, but Spiromesifen 22.9% SC was the least effective.

The data on mean percent fruit infestation (3rd, 5th and 10th day) after second spray showed that all insecticidal treatments considerably reduced the percent fruit infection as compared to the control (46.22%). Lamda cyhalothrin 5% EC (12.49%) was shown to be the most effective treatment followed by spinosad 45% SC (16.51%) and chlorantraniliprole 18.5% SC (17.86%). The treatments azadirachtin 1500 ppm (22.13%) and acephate 75% SP (24.63%) were on par. Fipronil 5% SC (29.43%) was next effective treatment. Compared to the other treatments, spiromesifen 22.9% SC (36.71%) and imidacloprid 70% WG (32.97%) were found to be less effective, while spiromesifen 22.9% SC was the least effective.

Cumulative mean of two sprays shown that all treatments were effective in controlling percent infestation of fruit fly compared to control (45.65%). Lamda cyhalothrin 5% EC (14.44%) was highly effective in controlling fruit fly followed by spinosad 45% SC (18.66%) and chlorantraniliprole 18.5% SC (19.77%). The treatments azadirachtin 1500 ppm (24.61%) and acephate 75% SP (26.97%) were at par. Fipronil 5% SC (31.83%) was next effective treatment. Spiromesifen 22.9% SC (40.54%) and imidacloprid 70% WG (36.03%) were found to be less effective, while spiromesifen 22.9% SC was the least effective.

The present findings are in line with the Sharma and Gupta. (2022) [7] who found that lamda cyhalothrin 5% EC was best treatment in reducing the percent fruit infestation due to fruit fly as compared to other trearments. It reduced the percent fruit infestation by 76.18% compared to control.

Red pumpkin beetle

The data on mean population of red pumpkin beetle (1st, 5th and 10th day) after first spray showed that, the most efficient and superior method for controlling beetles was determined to be chlorantraniliprole 18.5% SC (3.13 beetles per plant) followed by spinosad 45% SC (3.27 beetles per plant) and lamda cyhalothrin 5% EC (3.64 beetles per plant), three of them were at par. The next two most successful treatments fipronil 5% SC (4.24 beetles per plant) and Acephate 75% SP (4.14 beetles per plant) were almost on par. The effectiveness of other treatments such as azadirachtin 1500 ppm (4.59 beetles per plant), imidacloprid 70% WG (4.79 beetles per plant) and spiromesifen 22.9% SC (4.85 beetles per plant) were less. The least effective was spiromesifen 22.9% SC.

The data on mean population of red pumpkin beetle (1st, 5th and 10th day) after second spray showed that, compared to the control (5.38 beetles per plant), all treatments were effective in reducing the number of beetles. Chlorantraniliprole 18.5% SC (1.88 beetles per plant) was found to be the most effective and superior treatment for conrol of beetles which was at par with spinosad 45% SC (2.01 beetles per plant) and lamda cyhalothrin 5% EC (2.29 beetles per plant). The following treatments fipronil 5% SC (2.72 beetles per plant) and acephate 75% SP (2.59 beetles per plant) were on par. The other treatments including azadirachtin 1500 ppm (3.05 beetles per plant), imidacloprid 70% WG (3.27 beetles per plant) and spiromesifen 22.9% SC (3.36 beetles per plant) were less effective. Spiromesifen 22.9% SC was the least effective.

All the treatments were effective in reducing the number of red pumpkin beetles compared to control (5.38 beetles per plant). Chlorantraniliprole 18.5% SC was found to be the most effective treatment with less number of beetles (2.62) followed by spinosad 45% SC (2.75 beetles per plant) which were on par. Lamda cyhalothrin 5% EC (2.96 beetles per plant) was next best treatment. Fipronil 5% SC (3.36 beetles per plant) and acephate 75% SP (3.48 beetles per plant) were at par. The effectiveness of the other treatments were in the order azadirachtin 1500 ppm (3.82 beetles per plant) > imidacloprid 70% WG (4.11 beetles per plant) > spiromesifen 22.9% SC (4.67 beetles per plant). Spiromesifen 22.9% SC was the least effective treatment.

The present findings are in line with Zahid *et al.* (2017) [8] who recorded that lamda cyhalothrin was very effective in reducing leaf damage caused by red pumpkin beetle. Misra and Mukerjee (2012) [11] found that cyantraniliprole and spinosad were very effective in controlling red pumpkin beetle.

The study further indicated that chlorantraniliprole 18.5% SC outperformed all other insecticidal treatments with a yield of 10.58 t/ha and a maximum (48.80%) increase over the control. Lamda cyhalothrin 5% EC (10.3 t/ha) came next, which increased yield over control by 44.80%. The order with the higher yield was followed by Spinosad 45% SC (10.14 t/ha), which had a 42.60% increase in yield above the control. The sequence in descending order was chlorantraniliprole 18.5% SC > lamda cyhalothrin 5% EC > spinosad 45% SC > acephate 75% SP > imidacloprid 70% WG > fipronil 5% SC > spiromesifen 22.9% SC > azadirachtin 1500 ppm.

The result of the present investigation are in agreement with the result of Hirekurubar and Tatagar (2018) [6] who reported the highest yield in chlorantraniliprole 18.5 SC (98.48 q/ha) which was found to be at par with spinosad 45 SC.

The data on net monetary returns due to different insecticides clearly indicated that the highest net return (Rs.101670/ha) was recorded from chlorantraniliprole 18.5% SC treatment followed by lamda cyhalothrin 5% EC (Rs. 92980/ha), spinosad 45% SC (Rs. 84940/ha), acephate 75% SP (Rs. 77320/ha), imidacloprid 70% WG (Rs. 67188), fipronil 5% SC (Rs. 499080), spiromesifen 22.9% SC (Rs. 39020) and azadirachtin 1500 ppm (Rs 33488/ha).

The highest ICBR of (1:41.83) was registered by chlorantraniliprole 18.5% SC and it was followed by lamda cyhalothrin 5% EC (1:34.18), acephate 75% SP (1:27.81), imidacloprid 70% WG (1:20.28), spinosad 45% SC (1:14.25), fipronil 5% SC (1:11.56), azadirachtin 1500 ppm (1:7.76) and spiromesifen 22.9% SC (1:6.86).

Table 1: Efficacy of selected insecticides against leaf miner (*Liriomyza trifoli*) in cucumber

Sr. No	Treatments	Dose (g or ml/ha)	Mean percent leaf infestation of leaf miner										Percent reduction over control
			First spray					Second spray				Overall mean	
			Pre count	1 DAS	5 DAS	10 DAS	Mean	1 DAS	5 DAS	10 DAS	Mean		
1	Lamda cyhalothrin 5% EC	15	35.65 (36.66)	20.62 (26.99)	18.59 (25.54)	22.30 (28.18)	20.50 (27.00)	17.16 (24.46)	15.61 (23.27)	13.41 (21.49)	15.39 (23.07)	17.94 (25.03)	49.49
2	Acephate 75% SP	292	36.23 (37.01)	28.17 (32.05)	26.11 (30.72)	27.91 (31.89)	27.39 (31.55)	22.20 (28.09)	20.47 (26.89)	18.27 (25.32)	20.31 (26.76)	23.85 (29.15)	32.67
3	Fipronil 5% SC	50	34.43 (35.93)	25.41 (30.26)	23.45 (28.96)	25.62 (30.41)	24.82 (29.87)	20.05 (26.60)	18.76 (25.66)	16.22 (23.76)	18.34 (25.34)	21.58 (27.60)	39.07
4	Chlorantraniliprole 18.5% SC	10	37.23 (37.60)	16.14 (23.68)	14.73 (22.56)	18.88 (25.75)	16.58 (23.99)	15.58 (23.25)	13.58 (21.62)	11.46 (19.80)	13.54 (21.64)	14.56 (22.81)	58.89
5	Spinosad 45% SC	15	33.76 (35.52)	14.87 (22.68)	12.41 (20.61)	17.97 (25.08)	15.08 (22.79)	14.51 (22.39)	12.39 (20.60)	10.45 (18.84)	12.45 (20.61)	13.76 (21.70)	61.15
6	Imidacloprid 70% WG	24.5	35.67 (36.67)	32.31 (34.64)	30.55 (33.55)	31.26 (33.99)	31.37 (34.06)	27.59 (31.69)	26.57 (31.02)	21.56 (27.68)	25.24 (30.13)	28.30 (32.09)	20.10
7	Spiromesifen 22.9% SC	96	34.98 (36.26)	33.06 (35.10)	33.04 (35.08)	32.51 (34.76)	32.87 (34.98)	29.28 (32.76)	28.27 (32.12)	22.95 (28.63)	26.83 (31.17)	29.85 (33.07)	15.73
8	Azadirachtin 1500 ppm	-	35.56 (36.61)	31.43 (34.09)	29.72 (33.04)	29.67 (33.00)	30.27 (33.37)	25.25 (30.16)	23.61 (29.07)	20.23 (26.74)	23.03 (28.65)	26.65 (31.01)	24.76
9	Untreated control	-	35.34 (36.48)	35.34 (36.47)	35.31 (36.46)	35.63 (36.65)	35.42 (36.52)	35.72 (36.70)	35.25 (36.41)	35.89 (36.81)	35.62 (36.64)	35.52 (36.75)	-
S.E ±			NS	0.61	0.40	0.41	0.47	0.36	0.35	0.36	0.36	0.41	-
C.D at 5%			-	1.94	1.19	1.23	1.45	1.09	1.03	1.09	1.07	1.06	-

(Figures in the parenthesis are arc sin transformed values)

Table 2: Efficacy of selected insecticides against aphid (*Aphis gossypi*) in cucumber

Sr. No	Treatments	Dose (g or ml/ha)	No. of aphids per three leaves of a plant									Percent reduction over control
			First spray					Second spray			Overall mean	
			Pre count	1 DAS	5 DAS	10 DAS	Mean	1 DAS	5 DAS	10 DAS	Mean	
1	Lamda cyhalothrin 5% EC	15	61.23 (8.32)	41.20 (6.92)	35.23 (6.44)	51.37 (7.67)	42.60 (7.01)	36.01 (6.50)	31.46 (5.83)	27.29 (5.42)	31.58 (6.11)	37.09 (6.59)	38.67
2	Acephate 75% SP	292	59.90 (8.23)	27.39 (5.73)	21.98 (5.19)	37.09 (6.59)	28.82 (5.83)	22.54 (5.25)	17.50 (4.68)	13.23 (4.13)	17.76 (4.71)	23.29 (5.33)	61.49
3	Fipronil 5% SC	50	62.86 (8.42)	33.95 (6.33)	27.76 (5.77)	43.78 (7.12)	35.17 (6.40)	28.96 (5.88)	23.80 (5.38)	19.53 (4.92)	24.09 (5.41)	29.63 (5.94)	51.01
4	Chlorantraniliprole 18.5% SC	10	61.39 (8.33)	29.14 (5.90)	23.04 (5.30)	39.45 (6.78)	30.54 (5.99)	24.57 (5.46)	19.24 (4.88)	15.41 (4.43)	19.74 (4.94)	25.14 (5.51)	58.43
5	Spinosad 45% SC	15	60.33 (8.26)	37.36 (6.61)	31.31 (6.09)	47.36 (7.38)	38.67 (6.71)	32.64 (5.26)	27.57 (4.69)	23.73 (4.20)	27.98 (5.79)	33.33 (6.27)	44.89
6	Imidacloprid 70% WG	24.5	62.55 (8.40)	21.25 (5.11)	15.94 (4.49)	31.92 (6.15)	23.04 (5.25)	17.01 (4.62)	12.40 (4.02)	8.49 (3.41)	12.64 (4.05)	17.84 (4.72)	70.50
7	Spiromesifen 22.9% SC	96	59.03 (8.18)	23.26 (5.32)	17.82 (4.72)	33.10 (6.25)	24.73 (5.43)	18.37 (4.78)	13.38 (4.16)	9.40 (3.56)	13.72 (4.20)	19.22 (4.88)	68.22
8	Azadirachtin 1500 ppm	-	60.51 (8.27)	45.63 (7.25)	38.78 (6.73)	55.41 (7.94)	46.61 (7.31)	40.93 (6.90)	35.51 (6.46)	31.28 (6.09)	35.91 (6.49)	41.26 (6.92)	31.78
9	Untreated control	-	61.29 (8.32)	59.75 (8.23)	59.97 (8.24	60.85 (8.30)	60.19 (8.26)	60.86 (8.30)	60.40 (8.27)	61.05 (8.31)	60.77 (8.30)	60.48 (8.28)	-
S.E ±			NS	0.09	0.11	0.11	0.10	0.08	0.08	0.09	0.08	0.09	-
C.D at 5%			-	0.26	0.29	0.34	0.29	0.25	0.23	0.26	0.25	0.27	-

(Figures in the parenthesis are square root transformed values)
(Figures in the parenthesis are arc sin transformed values)

Table 3: Efficacy of selected insecticides against fruit fly (*Bactrocera cucurbitae*) infesting cucumber.

Sr. No	Treatments	Dose (g or ml/ha	Percent fruit infestation										Percent reduction over control
			First spray					Second spray				Overall mean	
			Pre count	3 DAS	5 DAS	10 DAS	Mean	3 DAS	5 DAS	10 DAS	Mean		
1	Lamda cyhalothrin 5% EC	15	43.34 (41.17)	17.43 (24.68)	15.45 (25.18)	16.26 (23.78)	16.40 (24.18)	14.45 (22.31)	12.48 (20.64)	10.55 (18.90)	12.49 (20.61)	14.44 (22.39)	68.37
2	Acephate 75% SP	292	44.87 (42.06)	31.12 (33.91)	27.49 (32.96)	29.26 (32.74)	29.31 (33.16)	27.48 (31.60)	24.73 (29.82)	21.69 (27.76)	24.63 (29.72)	26.97 (31.44)	40.92
3	Fipronil 5% SC	50	42.14 (40.48)	35.49 (36.56)	32.77 (34.85)	34.33 (35.87)	34.23 (36.04)	31.58 (34.19)	29.31 (32.77)	27.40 (31.55)	29.43 (32.83)	31.83 (34.43)	30.27
4	Chlorantraniliprole 18.5% SC	10	45.67 (42.52)	22.26 (28.15)	21.50 (29.40)	21.29 (27.48)	21.68 (27.97)	19.44 (26.14)	17.49 (24.72)	16.66 (24.09)	17.86 (24.98)	19.77 (26.47)	56.69
5	Spinosad 45% SC	15	44.87 (42.06)	22.47 (28.30)	20.52 (27.48)	20.59 (26.99)	21.21 (27.86)	18.48 (25.44)	16.45 (23.87)	14.62 (22.44)	16.51 (23.91)	18.66 (25.88)	59.12
6	Imidacloprid 70% WG	24.5	43.26 (41.13)	40.41 (39.47)	38.13 (37.72)	38.78 (38.51)	39.10 (39.02)	35.40 (36.51)	32.94 (35.02)	30.59 (33.58)	32.97 (35.03)	36.03 (37.02)	21.07
7	Spiromesifen 22.9% SC	96	42.28 (40.56)	46.33 (42.90)	43.24 (40.36)	43.48 (41.25)	44.37 (42.31)	40.42 (39.48)	36.78 (37.33)	32.93 (35.02)	36.71 (37.27)	40.54 (39.79)	11.19
8	Azadirachtin 1500 ppm	-	44.37 (41.77)	28.89 (32.51)	26.05 (31.07)	26.44 (30.94)	27.09 (31.88)	24.50 (29.67)	22.56 (28.36)	19.34 (26.08)	22.13 (28.03)	24.61 (29.95)	46.09
9	Untreated control	-	45.23 (42.26)	46.68 (43.10)	45.27 (42.29)	43.39 (41.20)	45.11 (42.20)	46.83 (43.18)	46.55 (43.02)	45.30 (42.30)	46.22 (42.83)	45.65 (42.51)	-
S.E ±			NS	0.76	0.77	0.64	0.91	0.70	0.67	0.72	0.69	0.69	-
C.D at 5%			-	2.26	2.31	1.92	2.73	2.79	2.01	2.15	2.31	2.15	-

(Figures in the parenthesis are arc sine transformed values)

Table 4: Efficacy of Insecticides Against Red Pumpkin Beetle (*Aulacophora foveicollis* L) infesting Cucumber

Sr. No	Treatments	Dose (g or ml/ha)	No. of beetles per plant									Percent reduction over control
			First spry					Second spray			Overall mean	
			1 DBS	1 DAS	5 DAS	10 DAS	Mean	1 DAS	5 DAS	10 DAS	Mean	
1	Lamda cyhalothrin 5% EC	15	5.31 (2.64)	3.84 (2.46)	3.42 (2.33)	3.66 (2.41)	2.73 (2.15)	3.32 (2.32)	3.13 (2.27)	2.72 (2.15)	2.29 (1.68)	2.96 (2.22)	44.77
2	Acephate 75% SP	292	5.41 (2.80)	4.32 (2.58)	3.89 (2.47)	4.23 (2.56)	4.14 (2.53)	3.71 (2.43)	3.52 (2.38)	3.12 (2.27)	2.59 (1.77)	3.48 (2.36)	37.31
3	Fipronil 5% SC	50	5.48 (2.89)	4.40 (2.60)	4.02 (2.52)	4.31 (2.58)	4.24 (2.55)	3.83 (2.46)	3.70 (2.42)	3.33 (2.33)	2.72 (1.80)	3.36 (2.33)	35.07
4	Chlorantraniliprole 18.5% SC	10	5.11 (2.74)	3.55 (2.38)	2.70 (2.14)	3.16 (2.28)	3.13 (2.26)	2.85 (2.19)	2.41 (2.05)	2.27 (2.01)	1.88 (1.56)	2.62 (2.11)	51.11
5	Spinosad 45% SC	15	5.27 (2.72)	3.71 (2.42)	2.86 (2.20)	3.24 (2.30)	3.27 (2.30)	3.01 (2.24)	2.60 (2.11)	2.42 (2.05)	2.01 (1.60)	2.75 (2.15)	48.69
6	Imidacloprid 70% WG	24.5	5.58 (2.78)	4.86 (2.70)	4.69 (2.67)	4.83 (2.70)	3.59 (2.39)	4.52 (2.63)	4.46 (2.61)	4.11 (2.53)	3.27 (1.94)	4.11 (2.52)	23.32
7	Spiromesifen 22.9% SC	96	5.23 (2.71)	4.91 (2.72)	4.72 (2.67)	4.93 (2.72)	4.85 (2.70)	4.63 (2.65)	4.53 (2.63)	4.27 (2.57)	3.36 (1.96)	4.67 (2.66)	12.87
8	Azadirachtin 1500 ppm	-	5.59 (2.77)	4.64 (2.65)	4.48 (2.62)	4.67 (2.66)	4.59 (2.64)	4.33 (2.58)	4.10 (2.52)	3.76 (2.44)	3.05 (1.89)	3.82 (2.45)	28.73
9	Untreated control	-	5.14 (2.61)	5.41 (2.83)	5.42 (2.82)	5.32 (2.80)	5.38 (2.81)	5.36 (2.81)	5.41 (2.82)	5.38 (2.81)	5.36 (2.81)	5.38 (2.81)	-
S.E ±			NS	0.02	0.01	0.02	0.02	0.03	0.02	0.03	0.03	0.02	-
C.D at 5%			-	0.06	0.03	0.06	0.07	0.09	0.07	0.08	0.08	0.05	-

Table 5: Effect of Selected Insecticides on Marketable Fruit Yield of Cucumber

Sr. No	Treatments	Dose (g a.i./ha)	Marketable fruit yield		Percent increase over control
			Kg/plot	t/ha	
1	Lamda cyhalothrin 5% EC	15	9.32	10.3	44.8
2	Acephate 75% SP	292	8.81	9.78	37.55
3	Fipronil 5%SC	50	8.03	8.92	25.45
4	Chlorantraniliprole 18.5% SC	10	9.53	10.58	48.80
5	Spinosad 45% SC	15	9.13	10.14	42.60
6	Imidacloprid 70% WG	24.5	8.52	9.46	33.05
7	Spiromesifen 22.9% SC	96	7.74	8.60	20.95
8	Azadirachtin 1500 ppm	-	7.54	8.37	17.72
9	Untreated control	-	6.44	7.11	--
SEM			0.1		
CD at 5%			0.29		

Table 6: Cost economics of different selected insecticides in cucumber

Sr. No	Treatments	Dose (g a.i./ha)	Quantity of insecticide/ ha/application	Yield (t/ha)	Increase in yield over control (B)	Value of increase in yield (C)	Treatment cost for two application (Rs/ha) (A)	Net profit (D)	ICBR (D/A)
1	Lamda cyhalothrin 5% EC	15	300	10.3	3.19	95700	2720	92980	1:34.18
2	Acephate 75% SP	292	390	9.78	2.67	80100	2780	77320	1:27.81
3	Fipronil 5% SC	50	800	8.92	1.81	54300	4320	49980	1:11.56
4	Chlorantraniliprole18.5%SC	10	50	10.58	3.47	104100	2430	101670	1:41.83
5	Spinosad 45% SC	15	600	10.14	3.03	90900	5960	84940	1:14.25
6	Imidacloprid 70% WG	24.5	35.0	9.46	2.35	70500	3312	67188	1:20.28
7	Spiromesifen 22.9% SC	96	400	8.60	1.49	44700	5680	39020	1:6.86
8	Azadirachtin 1500 ppm	--	2500	8.37	1.26	37800	4312	33488	1:7.76
9	Untreated control			7.11					

Conclusion

Spinosad 45% SC recorded the lowest percent infestation (13.76%) of leaf miner, imidacloprid 70% WG (17.84 aphids per three leaves) was superior treatment in control of aphids, lamda cyhalothrin 5% EC (14.44%) was highly effective in controlling fruit fly compared to other treatments and chlorantraniliprole 18.5% SC was found to be the most effective treatment in controlling red pumpkin beetles (2.12/plant). Chlorantraniliprole 18.5% SC was effective in control long all the four pests selected for evaluation. Hence it can be recommended for farmers. Chlorantraniliprole 18.5% SC recorded the highest ICBR ratio 1:41.83 with net returns of Rs 101670.

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