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Effect of different insecticides on natural enemies spider in brinjal ecosystem

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Abstract

A field study was conducted to evaluate the safety of insecticides against natural enemies' spiders in brinjal ecosystem. The field trial was conducted at Old campus Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut during the *Zaid* season of 2019 & 2020. The crop brinjal variety Pusa Purple long was grown in a randomized block design with nine treatments *viz.*, spinosad 45 EC @ 0.30 ml per liter of water, Emamectin benzoate 5% SG @ 0.5 gm per liter of water, Indoxacarb 14.5 SC @ 1.0 ml per liter of water, Profenophos 50EC @ 2.0 ml per liter of water, Lambda cyhalothrin @ 1.0 ml per liter of water, Quinalphos 20 EC @ 2.0 ml per liter, *Bacillus thuringiensis* @ 2 gm per liter of water, neem oil (1500ppm) @ 5 ml per liter of water and untreated control, replicated thrice. Plot size was 5 x 4 m² with spacing of 60 cm x 60 cm row to row and plant to plant, respectively. The natural enemies population of spiders was count on five randomly selected plants in each plot 10-day- intervals starting from 21 DAT. The natural enemies count was taken in all treatments. The population count of spiders was recorded on five randomly selected plants /plot. Pre- spray count was made a day before spraying and post spray counts were made at 7 and 14 days after each insecticidal application. The maximum population of spiders with After seven and fourteen days of second spray, among all the treatments the maximum pooled population of spiders was recorded in untreated control with 2.00 and 3.83 spiders per five plants and followed by *Bacillus thuringiensis* @ 2.0 gm per liter of water, neem oil (1500 ppm) @ 5.0 ml per litre of water, Emamectin benzoate 5% SG @ 0.5 gm per liter of water, Indoxacarb 14.5 SC @ 1.0 ml per liter of water, spinosad 45% SC @ 0.3 ml per liter of water, Profenophos 50EC @ 2.0ml per liter of water, Lambda- cyhalothrin @ 1.0 per liter of water and Quinalphos 20EC @ 2.0 ml per of water plants, respectively. The most harmful treatment was Quinalphos 20EC @ 2.0 ml per of water with spiders population of 2.67, 2.33, 2.17, 1.83, 1.67 0.67, 0.33 and 0.50 spiders per five plants, respectively. After seven days of spray the minimum population of spiders was found in treatment Quinalphos 20EC @ 2.0 ml per of water plants water with 0.50 spiders per five plants. the maximum adults population of spiders was recorded with *Bacillus thuringiensis* @ 2.0 gm per liter of water, neem oil (1500 ppm) @ 5.0 ml per litre of water, Emamectin benzoate 5% SG @ 0.5 gm per liter of water, Indoxacarb 14.5 SC @ 1.0 ml per liter of water, spinosad 45% SC @ 0.3 ml per liter of water, Profenophos 50EC @ 2.0ml per liter of water, Lambda- cyhalothrin @ 1.0 per liter of water and Quinalphos 20EC @ 2.0 ml per of water plants, respectively. The lowest population was recorded in the treatment Quinalphos 20EC @ 2.0 ml per of water. The treatments, *Bacillus thuringiensis* @ 2.0 gm per liter of water and neem oil (1500 ppm) @ 5.00 ml per liter water were found safe against spiders population.

Keywords: Treatments, spiders, natural enemies, brinjal

Introduction

The brinjal (*Solanum melongena* L.) belongs to family Solanaceae is one of the most important vegetables crops native of India and it is often described as the king of vegetable grown throughout the country especially in North region. At the same time, vegetable cultivation is becoming more costly due to the increasing use of purchased inputs such as pesticides and fertilizers to sustain production levels. These inputs are also a cause for concern due to their deleterious effect on human health and the environment. Among the major insect pests, brinjal shoot and fruit borer (BSFB), *Leucinodes orbonalis* is considered the most destructive pest of brinjal in India. Although a vegetable ecosystem is rich in natural enemies complex, few studies have been systematically done to record and management of insect pests. Egg plant *Solanum melongena*, is one such typical vegetable in that its cultivation helps to improve human nutrition and income generation. Eggplant is especially important in South Asia (Bangladesh, India, Nepal and Sri Lanka).

Often, farmers are spraying up to 10-30 spray per season to save the crop. Over use of synthetic pesticides increase the cost of production at farmer level and increase the environmental and health hazards at the consumer level. This excessive pesticides usage threatens the farmers and consumers, pollutes the environment, besides making it costly to consumers. At the same time, frequent use of pesticides has made this insect tolerant to the chemicals, making it more difficult to control.

Materials and Methods

The field trial was conducted at Old campus Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut during the *Zaid* season of 2019 & 2020. The crop brinjal variety Pusa Purple long was grown in a randomized block design with nine treatments *viz.*, spinosad 45 EC @ 0.30 ml per liter of water Emamectin benzoate 5% SG @ 0.5 gm per liter of water, Indoxacarb 14.5 SC @ 1.0 ml per liter of water, Profenophos 50EC @ 2.0 ml per liter of water, Lambda cyhalothrin @ 1.0 ml per liter of water, Quinalphos 20 EC @ 2.0 ml per liter, *Bacillus thuringiensis* @ 2 gm per

liter of water, neem oil (1500ppm) @ 5 ml per liter of water and untreated control, replicated thrice. Plot size was 5 x 4 m² with spacing of 60 cm x 60 cm row to row and plant to plant, respectively. The natural enemies population of spiders was count on five randomly selected plants in each plot 10-day-intervals starting from 21 DAT. The natural enemies count was taken in all treatments. The population count of spiders was recorded on five randomly selected plants /plot. Pre-spray count was made a day before spraying and post spray counts were made at 7 and 14 days after each insecticidal application.

Result During the course of investigation, two natural enemies' *viz.*, spiders were recorded. The data on effect of different treatment on natural enemies of brinjal.

One day before first spray

The data regarding effect of different treatments on mean population of Spiders at one day before spray ranged from 1.67 to 2.33 spiders per five plants. No significant difference was found among all the different treatments at one day before spray (Table 1.1)

Table 1.1: Bio efficacy of some bio-pesticides and newer insecticides on Spiders in brinjal during *Zaid*, 2019

S. No.	Treatments	Dose / lit. water	No. of Spiders / 5plants						
			DBS	First spray		Second spray		Third spray	
				7 DAS	14 DAS	7 DAS	14 DAS	7 DAS	14 DAS
1	Spinosad 45% SC	0.3ml/lit	2.33 (1.52)	2.00 (1.58)	1.00 (1.22)	1.33 (1.34)	1.00 (1.22)	0.67 (1.05)	0.33 (0.88)
2	Emamectin Benzoate 5% SG	0.5gm/lit	2.00 (1.41)	1.67 (1.46)	1.33 (1.34)	2.00 (1.56)	1.67 (1.46)	1.33 (1.34)	1.00 (1.22)
3	Indoxacarb 14.5SC	1.0ml/lit	1.67 (1.28)	1.33 (1.34)	1.00 (1.22)	1.67 (1.46)	1.33 (1.34)	1.00 (1.22)	0.67 (1.05)
4	Quinalphos	2.0 ml/lit	2.33 (1.52)	1.00 (1.22)	0.33 (0.88)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)
5	Profenophos 50EC	2.0 ml/lit	2.00 (1.41)	1.67 (1.46)	0.67 (1.05)	0.33 (0.88)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)
6	Lambda – cyhalothrin	1.0 ml/lit	2.33 (1.52)	1.33 (1.34)	0.33 (0.88)	0.00 (0.71)	0.00 (0.88)	0.00 (0.71)	0.00 (0.71)
7	<i>Bacillus thuringiensis</i>	2.0gm/lit	2.00 (1.41)	2.00 (1.58)	1.67 (1.46)	2.33 (1.68)	2.33 (1.68)	2.00 (1.58)	1.67 (1.46)
8	Neem oil (1500 ppm)	5.0 ml/lit	2.00 (1.38)	2.00 (1.58)	1.33 (1.46)	1.67 (1.46)	1.67 (1.46)	1.33 (1.34)	1.00 (1.22)
9	Untreated control	-	2.00 (1.41)	2.33 (1.68)	2.67 (1.77)	3.00 (1.87)	3.33 (1.95)	3.67 (2.04)	4.00 (2.04)
SEm±			-	0.09	0.12	0.13	0.10	0.09	0.09
CD at 5%			NS	0.27	0.35	0.38	0.29	0.27	0.28

Values in parentheses are square root transformed values,
 DBS = Day before spray,
 DAS = Day after spray

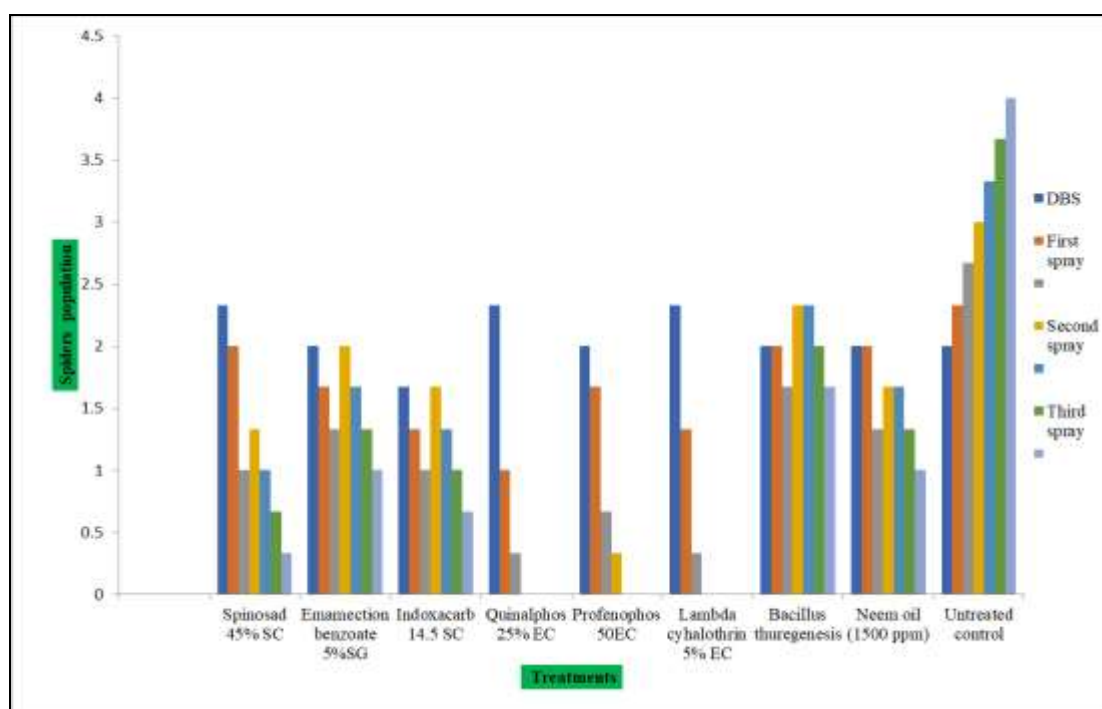


Fig 1.1: Bio efficacy of bio-pesticides and newer insecticides on spiders in brinjal during *Zaid*, 2019

After first spray

The statistically analyzed data presented in table 1.1 and depicted in fig. Revealed that three days after first spray the mean population of spiders ranged from 1.00 to 2.33 per five plants during *Zaid*, 2019. Among all the bio-pesticides and newer insecticides the maximum population of spiders with 2.00 and 2.00 per five plants were recorded in *Bacillus thuringiensis* @ 2 gm per liter of water and neem oil (1500ppm) @ 5 ml per liter of water, respectively. Whereas, the minimum population of spiders was recorded in Quinalphos 20 EC 2.00 ml per liter of water with 1.00 per five plants. The other treatments against spiders population were Emamectin benzoate 5% SG @ 0.5 gm per liter of water, Indoxacarb 14.5 SC @ 1.0 ml per liter of water, Spinosad 45% SC @ 0.3 ml per liter of water, Profenophos 50EC @ 2.0 ml per liter of water, Lambda cyhalothrin @ 1.0 ml per liter of water and Quinalphos 20 EC @ 2.0 ml per liter of water with 1.67, 2.00, 1.33, 1.67, 1.33 and 1.00 per five plants, respectively. Among all the treatments the maximum population of spiders was observed in untreated control with 2.33 per five plants.

Similar trend was observed at fourteen days after first spray during *Zaid*, 2019. The mean population of spiders ranged from 0.33 to 2.67 per five plants. Among all the treatments the maximum number of spider's population was recorded in untreated control with 2.67 per five plants and minimum in Quinalphos 20 EC @ 2.0 ml per liter of water with 0.33 per five plants. The other treatments against spiders population were *Bacillus thuringiensis* @ 2.0 gm per liter of water, neem oil (1500 ppm) @ 5.0 ml per liter of water, Emamectin benzoate 5% SG @ 0.5 gm per liter of water, Indoxacarb 14.5 SC @ 1.0 ml per liter of water, spinosad 45% SC 0.3 ml per liter of water, Profenophos 50EC @ 2.0ml per liter of water, Lambda cyhalothrin @ 1.0 ml per liter of water and Quinalphos 20 EC @ 2.0 ml per liter of water with 1.33, 1.00, 1.00, 0.67, 0.33 and 0.33 per five plants, respectively. Among all bio-pesticides and newer insecticides the maximum population of spiders was found with *Bacillus thuringiensis* with 1.67 per five plants.

After second spray

The data presented in table 4.21 and depicted in fig. Revealed that after seven days of second spray the highest number of spiders' population (3.00 per five plants) were observed with untreated control. Among all the bio-pesticides and newer insecticides the treatment *Bacillus thuringiensis* was found most safe with spiders population of 2.33 per five plants.

At Fourteen days after second spraying, the mean population of Spiders ranged from 0.00 to 3.33 spiders per five plants during *Zaid*, 2020. Among all the insecticidal treatments the maximum population of Spiders was noticed in *Bacillus thuringiensis* @ 2.0 gm per litre of water with 2.33 beetles per five plants. Whereas, the minimum population of spiders was found in Quinalphos 25 EC @ 2.0 gm per liter of water with 0.00 beetles per five plants. The other treatments against spiders population were Neem oil (1500 ppm) @ 5.0 ml per litre of water, Emamectin benzoate 5% SG @ 0.5 gm per litre of water, Indoxacarb14.5SC @ 1.0 ml per litre of water, Spinosad 45 SC @ 0.3 ml per litre of water, Profenophos 50EC @ 2.00 ml per liter of water, Lambda – cyhalothrin @ 1.0 ml per liter of water, and Quinalphos 20EC @ 2.0 ml of water with 1.67, 1.67, 1.00, 1.33, 0.00, 0.00 and 0.00 beetles per five plants, respectively. Among all the treatments the

maximum Spiders population was recorded in untreated control with 3.33 spiders per five plants.

After third spray

At seven days after third spraying, among all the insecticidal treatments the harmful treatment against spider's population was Quinalphos 25 EC @ 2.0 ml per liter of water which recorded with lowest population of 0.00 spiders per five plants. Whereas, least harmful treatment was Lambda cyhalothrin @ 1.0 ml per litre of water with 0.00 spiders per five plants and followed by Profenophos 50EC @ 2.0 ml per litre of water, Spinosad 45% SC 0.3 ml per litre of water, Indoxacarb14.5SC @ 1.0 ml per litre of water, Emamectin benzoate 5% SG @ 0.5 gm per litre of water, Neem oil (1500 ppm) @ 5.0 ml/lit, and *Bacillus thuringiensis* @ 2.0 ml/l. water with spiders population of 0.00, 0.00, 0.00, 0.67, 1.00, 1.33 and 2.00 spiders per five plants, respectively. The maximum spiders population with 3.67 per five plants was noticed in untreated control.

After seven days of third spray the treatment Lambda cyhalothrin @ 1.0 ml per litre of water was found statistically at par with Profenophos 50EC @ 2.0 ml per litre of water. The treatments Spinosad 45% SC 0.3 ml per liter of water and Indoxacarb 14.5 SC @ 1.0 ml per liter of water were found statistically at par to each other. The treatment Emamectin benzoate 5% @ 0.5 gm per liter of water was found at par with Neem oil (1500 ppm) EC @ 5.0 ml per liter of water. The treatments neem oil (1500 ppm) @ 5.00 ml per liter of water was also found statistically at par with *Bacillus thuringiensis* @ 2.0 gm per liter of water.

At fourteen days after third spraying, among all the insecticidal treatments the harmful treatment against spiders population was Quinalphos 25 EC @ 2.0 ml per liter of water which recorded with lowest population of 0.00 spiders per five plants. Whereas, least harmful treatment was Lambda cyhalothrin @ 1.0 ml per litre of water with 0.00 spiders per five plants and followed by Profenophos 50EC @ 2.0 ml per litre of water, Spinosad 45% SC 0.3ml per lit per litre of water, Indoxacarb14.5SC @ 1.0 ml per litre of water, Emamectin benzoate 5% SG @ 0.5 gm per litre of water, Neem oil (1500 ppm) @ 5.0 ml per liter of water and *Bacillus thuringiensis* @ 2.0 ml per liter of water with spiders population of 0.00, 0.00, 0.33, 0.67, 1.00, 1.00 and 1.67 spiders per five plants, respectively. The maximum spiders population with 4.00 spiders per five plants was noticed in untreated control.

After fourteen days of third spraying the treatments Quinalphos 25EC @ 2.0 ml per liter water was found statistically at par with Lambda- cyhalothrin @ 1.0 ml per liter of water and Profenophos 50EC @ 2.0 ml/ per litre of water. The treatments Spinosad 45SC @ 0.3 ml per litre of water, was found statistically at par with Indoxacarb14.5 SC @ 1.0 gm per litre of water. The treatments Indoxacarb 14.5 SC @ 1.0 ml per liter of water, was found statistically at par with Emamectin benzoate 5 % SG @ 0.3 ml per liter of water.

Effect of different treatments on Spiders population in brinjal during *Zaid*, 2020

The results on the mean population of spiders at one day before spray ranged from 2.00 to 3.00 spiders per five plants during *Zaid*, 2020. No significant difference was found among different treatments at one day before spray (table 1.2 and Fig.).

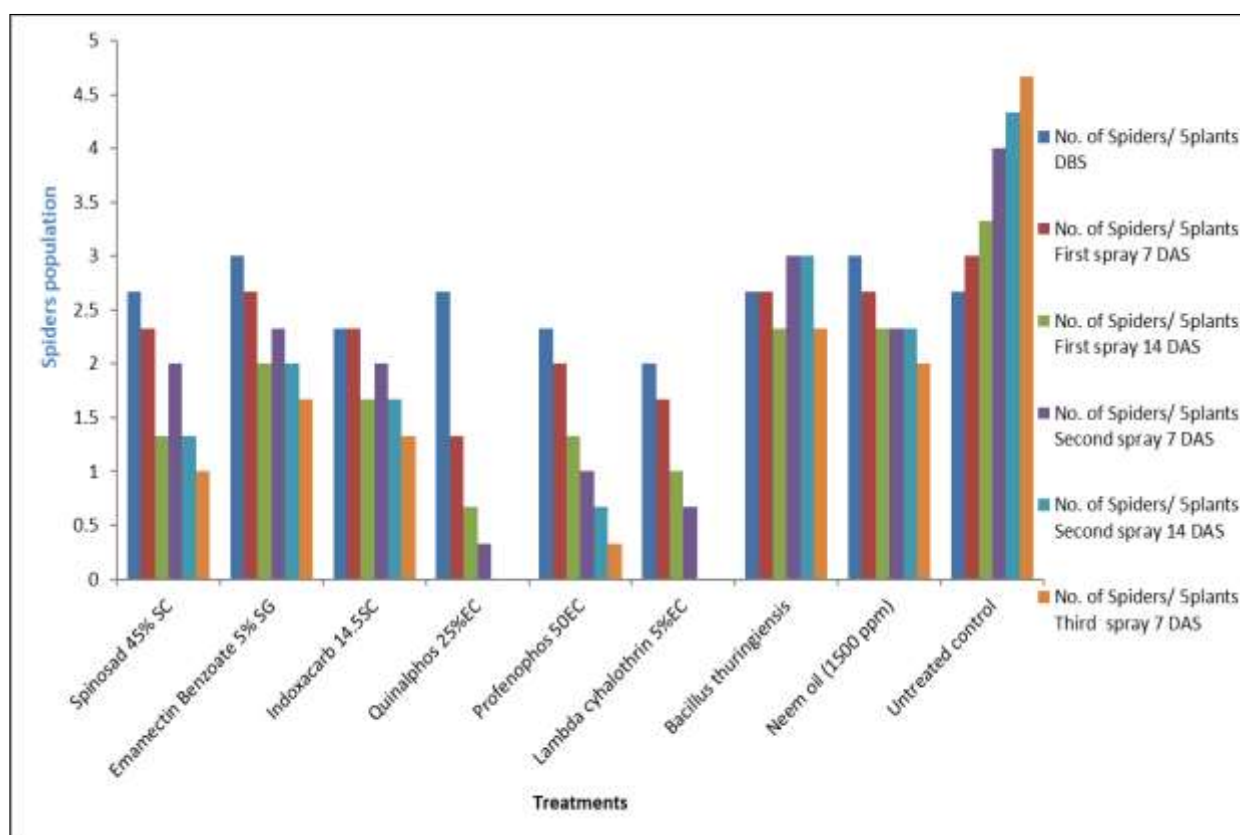
Table 1.2: Bio efficacy of some bio-pesticides and newer insecticides on Spiders in brinjal during *Zaid*, 2020

S. No.	Treatments	Dose / lit. water	No. of Spiders / 5plants						
			DBS	First spray		Second spray		Third spray	
				7 DAS	14 DAS	7 DAS	14 DAS	7 DAS	14 DAS
1	Spinosad 45% SC	0.3ml/lit	2.67 (1.63)	2.33 (1.68)	1.33 (1.34)	2.00 (1.58)	1.33 (1.34)	1.00 (1.22)	0.67 (1.05)
2	Emamectin Benzoate 5% SG	0.5gm/lit	3.00 (1.73)	2.67 (1.77)	2.00 (1.58)	2.33 (1.68)	2.00 (1.58)	1.67 (1.46)	1.33 (1.34)
3	Indoxacarb 14.5SCs	1.0ml/lit	2.33 (1.52)	2.33 (1.68)	1.67 (1.46)	2.00 (1.58)	1.67 (1.46)	1.33 (1.34)	1.00 (1.22)
4	Quinalphos	2.0 ml/lit	2.67 (1.63)	1.33 (1.34)	0.67 (1.05)	0.33 (0.88)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)
5	Profenophos 50EC	2.0 ml/lit	2.33 (1.52)	2.00 (1.58)	1.33 (1.34)	1.00 (1.22)	0.67 (1.05)	0.33 (0.88)	0.00 (0.71)
6	Lambda – cyhalothrin	1.0 ml/lit	2.00 (1.41)	1.67 (1.46)	1.00 (1.22)	0.67 (1.05)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)
7	<i>Bacillus thuringiensis</i>	2.0gm/lit	2.67 (1.63)	2.67 (1.77)	2.33 (1.68)	3.00 (1.87)	3.00 (1.87)	2.33 (1.68)	1.67 (1.46)
8	Neem oil (1500 ppm)	5.0 ml/lit	3.00 (1.73)	2.67 (1.77)	2.33 (1.68)	2.33 (1.68)	2.33 (1.68)	2.00 (1.58)	1.67 (1.46)
9	Untreated control	-	2.67 (1.63)	3.00 (1.87)	3.33 (1.95)	4.00 (2.12)	4.33 (2.20)	4.67 (2.27)	4.67 (2.27)
	SEm±		-	0.09	0.08	0.09	0.08	0.06	0.10
	CD at 5%		NS	0.28	0.23	0.27	0.24	0.18	0.29

Values in parentheses are square root transformed values

DBS = Day before spray

DAS = Day after spray

**Fig 1.2:** Bio efficacy of bio-pesticides and newer insecticides on spiders in brinjal during *Zaid*, 2020

After first spray

After seven days of first spraying, the statistically analyzed data on mean number of spiders presented in table 4.22 and depicted in fig. Among all the bio-pesticides and newer insecticides the highest population of spiders was noticed in *Bacillus thuringiensis* @ 2.0 gm per liter of water with 2.67 spiders per five plants and followed by Neem oil (1500 ppm) @ 5.0 ml per liter of water, Emamectin benzoate 5 SG @ 4.0 gm per liter of water, Indoxacarb 14.5SC @ 1.0 ml per litre of water, Spinosad 45 SC @ 0.3 ml per litre of water, Profenophos 50EC @ 2.0 ml per litre of water, Lambda – cyhalothrin @ 1.0 ml per litre of water and Quinalphos @ 2.0 ml/l. water with spiders population of 2.67, 2.67, 2.33, 2.33, 2.00, 1.67 and 3.00 spiders per five plants, respectively. Among all the treatments the maximum number of spiders was found in untreated control with 3.00 spiders per five

plants.

At fourteen days after first spraying, the mean population of spiders ranged from 0.67 to 3.33 spiders per five plants. Among all the treatments the maximum population of spiders with 3.33 spiders per five plants was observed in untreated control and followed by *Bacillus thuringiensis* @ 2.0 gm per liter of water with 2.33 spiders per five plants. The other treatments against spiders population were Neem oil (1500 ppm) @ 5.0 ml per litre of water, Emamectin benzoate 5% SG @ 0.5 gm per litre of water, Indoxacarb 14.5SC @ 1.0 ml per litre of water, Spinosad 45 SC @ 0.3 ml per litre of water, Profenophos 50EC @ 2 ml per litre of water, Lambda – cyhalothrin @ 1.0 ml per litre of water and Quinalphos 20EC @ 2.0 ml per liter of water with 2.33, 2.00, 1.67, 1.33, 1.00 and 0.67 spiders per five plants, respectively. Among all the bio-pesticides and newer insecticides the most effective

treatment was Quinalphos 20EC @ 2.0 ml per liter of water which recorded with minimum mean population of 0.67 spiders per five plants.

After second spray

After seven days of second spraying, the mean population of spiders ranged from 0.33 to 4.00 spiders per five plants. Among all the insecticidal treatments *Bacillus thuringiensis* @ 2.0 gm per litre of water was found least harmful against spiders with 3.00 spiders per five plants. The next treatments in the decreasing order of spiders population were Neem oil (1500 ppm) @ 5.0 ml per litre of water, Emamectin benzoate 5% SG @ 0.5 gm per litre of water, Indoxacarb14.5SC @ 1.0 ml per litre of water, Spinosad 45 SC @ 0.3 ml/l. per litre of water, Profenophos 50EC @ 2.00 ml per liter of water, Lambda – cyhalothrin @ 1.0 ml/liter of water and Quinalphos 20EC @ 2.0 ml of water with 2.33, 2.00, 2.00, 1.00, 0.67, 3.00 and 0.33 spiders per five plants, respectively. Among all the treatments the maximum population spiders was recorded in untreated control with 4.00 spiders per five plants.

At Fourteen days after second spraying, the mean population of spiders ranged from 0.00 to 4.33 spiders per five plants during *Zaid*, 2020. Among all the insecticidal treatments the maximum population of spiders was noticed in *Bacillus thuringiensis* @ 2.0 gm per litre of water with 3.00 spiders per five plants. Whereas, the minimum population of spiders was found in Quinalphos 25 EC @ 2.0 gm per liter of water with 2.33 spiders per five plants. The other treatments against spiders population were Neem oil (1500 ppm) @ 5.0 ml per litre of water, Emamectin benzoate 5% SG @ 0.5 gm per litre of water, Indoxacarb14.5SC @ 1.0 ml per litre of water, Spinosad 45 SC @ 0.3 ml per litre of water, Profenophos 50EC @ 2.00 ml per liter of water, Lambda – cyhalothrin @ 1.0 ml per liter of water, and Quinalphos 20EC @ 2.0 ml of water with 2.33, 2.00, 1.67, 1.33, 1.05, 0.00 and 0.00 spiders per five plants, respectively. Among all the treatments the maximum spiders population was recorded in untreated control with 4.33 spiders per five plants.

Similar trend was observed at seven days after second spray during *Zaid*, 2020. The mean population of spiders ranged from 0.00 to 4.33 spiders per five plants. The highest number of spiders population (4.33 spiders per five plants) was observed with untreated control. Among all the bio-pesticides and newer insecticides the treatment *Bacillus thuringiensis* 10 EC @ 2.0 gm per litre of water was found most safe with spiders population of 3.00 spiders per five plants. The other treatments in decreasing order of spiders population were Neem oil (1500 ppm) @ 5.0 ml per litre of water, Emamectin benzoate 5 SG @ 0.5 gm per litre of water, Indoxacarb14.5 SC @ 1.0 ml per litre of water, Spinosad 45 SC @ 0.3 ml/l. water, Profenophos 50EC @ 2.0 ml/liter, Lambda – cyhalothrin @ 1.0 ml per liter and Quinalphos 25 EC @ 2.0 ml/liter with spiders population of 2.33, 2.00, 1.67, 1.33, 0.67, 0.00 and 0.00 spiders per five plants, respectively. The most toxic treatment against spiders population was Quinalphos 25 EC @ 2.0 ml per liter of water recorded lowest population of 0.00 spiders per five plants.'

After third spray

At seven days after third spraying, among all the insecticidal treatments the harmful treatment against spiders population was Quinalphos 25 EC @ 2.0 ml per liter of water which recorded with lowest population of 0.00 spiders per five plants. Whereas, least harmful treatment was Lambda cyhalothrin @ 1.0 ml per litre of water with 0.00 spiders per five plants and followed by Profenophos 50EC @ 2.0 ml per litre of water, Spinosad 45% SC 0.3 ml per litre of water, Indoxacarb14.5SC @ 1.0 ml per litre of water, Emamectin benzoate 5% SG @ 0.5 gm per litre of water, Neem oil (1500 ppm) @ 5.0 ml/lit, and *Bacillus thuringiensis* @ 2.0 ml per liter of water with spiders population of 0.88, 1.00, 1.33, 1.67 and 1.00 spiders per five plants, respectively. The maximum spiders population with 4.67 spiders per five plants was noticed in untreated control.

After seven days of third spray the treatment Lambda cyhalothrin @ 1.0 ml per litre of water was found statistically at par with Profenophos 50EC @ 2.0 ml per litre of water. The treatments Spinosad 45% SC 0.3 ml per liter of water and Indoxacarb 14.5 SC @ 1.0 ml per liter of water were found statistically at par to each other. The treatment Emamectin benzoate 5% SG @ 0.5 gm per liter of water was found at par with *Bacillus thuringiensis* @ 2.0 gm per liter of water. The treatments neem oil (1500 ppm) @ 5.00 ml per liter of water was also found statistically at par with *Bacillus thuringiensis* @ 2.0 gm per liter of water.

At fourteen days after third spraying, among all the insecticidal treatments the harmful treatment against spiders population was Quinalphos 25 EC @ 2.0 ml per liter of water which recorded with lowest population of 0.00 spiders per five plants. Whereas, least harmful treatment was Lambda cyhalothrin @ 1.0 ml per litre of water with 0.00 spiders per five plants and followed by Profenophos 50EC @ 2.0 ml per litre of water, Spinosad 45% SC 0.3ml per lit per litre of water, Indoxacarb14.5SC @ 1.0 ml per litre of water, Emamectin benzoate 5% SG @ 0.5 gm per litre of water, Neem oil (1500 ppm) @ 5.0 ml per liter of water and *Bacillus thuringiensis* @ 2.0 ml per liter of water with spiders population of 0.00, 1.05, 1.22, 1.34, 1.67 and 1.67 spiders per five plants, respectively. The maximum spiders population with 4.67 spiders per five plants was noticed in untreated control.

After fourteen days of third spraying the treatments Quinalphos 25EC @ 2.0 ml per liter water was found statistically at par with Lambda- cyhalothrin @ 1.0 ml per liter of water and Profenophos 50EC @ 2.0 ml/ per litre of water. The treatments Spinosad 45SC @ 0.3 ml per litre of water, was found statistically at par with Indoxacarb14.5 SC @ 1.0 gm per litre of water. The treatments Indoxacarb 14.5 SC @ 1.0 ml per liter of water, was found statistically at par with Emamectin benzoate 5 % SG @ 0.3 ml per liter of water.

Pooled effect of bio efficacy of some bio-pesticides and newer insecticides on Spiders in brinjal during *Zaid*, 2019 and 2020

The pooled data regarding effect of bio-pesticides and newer insecticides on mean population of spiders at one day before spray ranged from 2.17 to 2.50 spiders per five plants (Table 1.3 and Fig.).

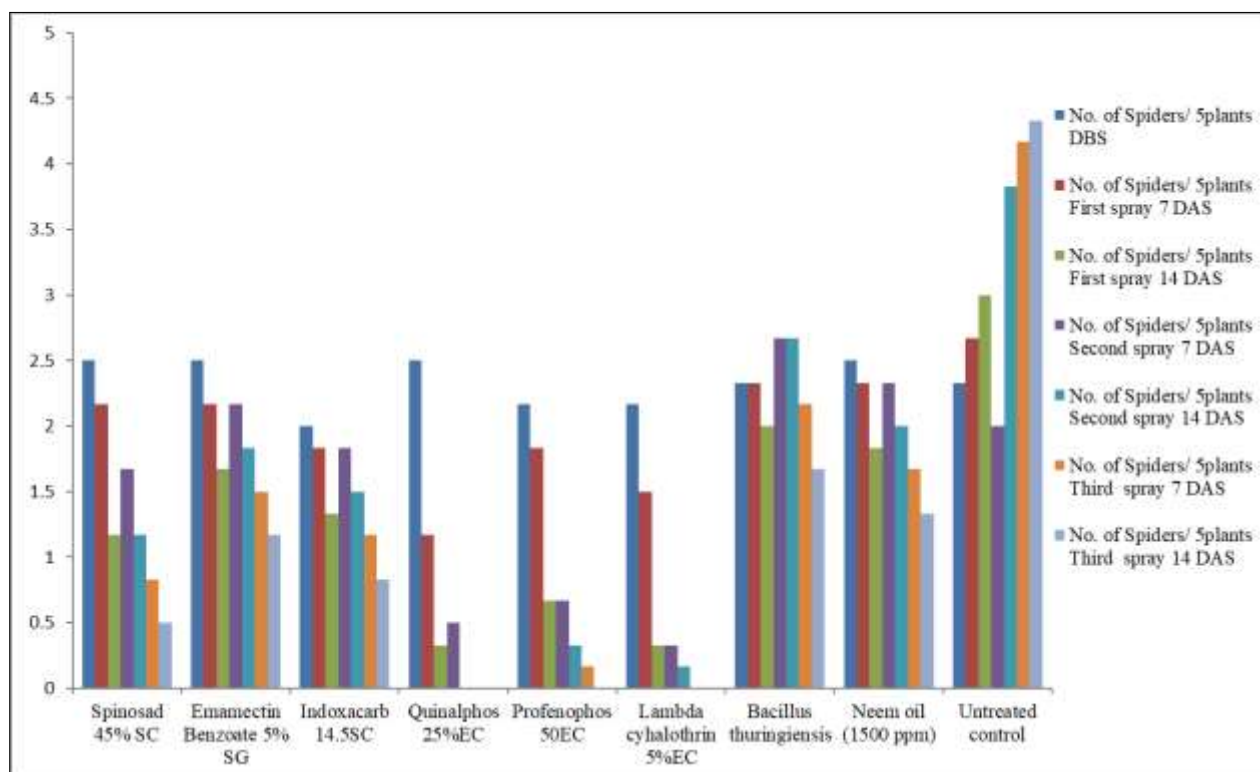
Table 1.3: Pooled bio- efficacy of some bio-pesticides and newer insecticides on Spiders in brinjal during *Zaid*, 2019 &2020

S. No.	Treatments	Dose / lit. water	No. of Spiders / 5plants						
			DBS	First spray		Second spray		Third spray	
				7 DAS	14 DAS	7 DAS	14 DAS	7 DAS	14 DAS
1	Spinosad 45% SC	0.3ml/lit	2.50 (1.58)	2.17 (1.63)	1.17 (1.29)	1.67 (1.47)	1.17 (1.29)	0.83 (1.15)	0.50 (0.98)
2	Emamectin Benzoate 5% SG	0.5gm/lit	2.50 (1.58)	2.17 (1.63)	1.67 (1.47)	2.17 (1.62)	1.83 (1.53)	1.50 (1.41)	1.17 (1.29)
3	Indoxacarb 14.5SC	1.0ml/lit	2.00 (1.41)	1.83 (1.53)	1.33 (1.35)	1.83 (1.53)	1.50 (1.41)	1.17 (1.29)	0.83 (1.15)
4	Quinalphos	2.0 ml/lit	2.50 (1.58)	1.17 (1.29)	0.33 (0.90)	0.50 (0.98)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)
5	Profenophos 50EC	2.0 ml/lit	2.17 (1.47)	1.83 (1.53)	0.67 (1.07)	0.67 (1.07)	0.33 (0.90)	0.17 (0.80)	0.00 (0.71)
6	Lambda – cyhalothrin	1.0 ml/lit	2.17 (1.47)	1.50 (1.41)	0.33 (0.90)	0.33 (0.90)	0.17 (0.80)	0.00 (0.71)	0.00 (0.71)
7	<i>Bacillus thuringiensis</i>	2.0gm/lit	2.33 (1.53)	2.33 (1.68)	2.00 (1.58)	2.67 (1.78)	2.67 (1.78)	2.17 (1.63)	1.67 (1.47)
8	Neem oil (1500 ppm)	5.0 ml/lit	2.50 (1.58)	2.33 (1.68)	1.83 (1.53)	2.33 (1.68)	2.00 (1.58)	1.67 (1.47)	1.33 (1.35)
9	Untreated control	-	2.33 (1.53)	2.67 (1.78)	3.00 (1.87)	2.00 (1.58)	3.83 (2.08)	4.17 (2.16)	4.33 (2.20)
	SEm±		-	0.05	0.08	0.08	0.06	0.05	0.07
	CD at 5%		NS	0.15	0.23	0.25	0.19	0.16	0.21

Values in parentheses are square root transformed values

DBS = Day before spray

DAS = Day after spray

**Fig 1.3:** Pooled data bio efficacy of bio-pesticides and newer insecticides on spiders in brinjal during *Zaid*, 2019 & 2020

The highest mean pooled population of spiders was recorded in untreated control with 2.67 and 3.00 spiders per five plants after seven and fourteen days of first spray, respectively. The next treatments in order after seven day of first spray were *Bacillus thuringiensis* @ 2.0 gm per liter of water, neem oil (1500 ppm) @ 5.0 ml per litre of water, Emamectin benzoate 5% SG @ 0.5 gm per liter of water, Indoxacarb 14.5 SC @ 1.0 ml per liter of water, spinosad 45% SC @ 0.3 ml per liter of water, Profenophos 50EC @ 2.0ml per liter of water, Lambda- cyhalothrin @ 1.0 per liter of water and Quinalphos 20EC @ 2.0 ml per of water with spiders population of 2.33, 2.33, 2.17, 2.17, 1.83, 1.83, 1.50 and 1.17 spiders per five plants, respectively.

After fourteen days of first spray the other treatments were followed by *Bacillus thuringiensis* @ 2.0 gm per liter of water, neem oil (1500 ppm) @ 5.0 ml per litre of water, Emamectin benzoate 5% SG @ 0.5 gm per liter of water, Indoxacarb 14.5 SC @ 1.0 ml per liter of water, spinosad 45%

SC @ 0.3 ml per liter of water, Profenophos 50EC @ 2.0ml per liter of water, Lambda- cyhalothrin @ 1.0 per liter of water and Quinalphos 20EC @ 2.0 ml per of water with spiders population of respectively. The most harmful treatment was Quinalphos 20EC @ 2.0 ml per of water which recorded minimum number of spiders population with 1.17 and 0.33 spiders per five plants after seven and fourteen days of first spray, respectively.

After seven and fourteen days of second spray, among all the treatments the maximum pooled population of spiders was recorded in untreated control with 2.00 and 3.83 spiders per five plants and followed by *Bacillus thuringiensis* @ 2.0 gm per liter of water, neem oil (1500 ppm) @ 5.0 ml per litre of water, Emamectin benzoate 5% SG @ 0.5 gm per liter of water, Indoxacarb 14.5 SC @ 1.0 ml per liter of water, spinosad 45% SC @ 0.3 ml per liter of water, Profenophos 50EC @ 2.0ml per liter of water, Lambda- cyhalothrin @ 1.0 per liter of water and Quinalphos 20EC @ 2.0 ml per of water

plants, respectively. The most harmful treatment was Quinalphos 20EC @ 2.0 ml per of water with spiders population of 2.67, 2.33, 2.17, 1.83, 1.67 0.67, 0.33 and 0.50 spiders per five plants, respectively. After seven days of spray the minimum population of spiders was found in treatment Quinalphos 20EC @ 2.0 ml per of water plants water with 0.50 spiders per five plants.

After seven and fourteen days of third spray, among all the treatments the maximum pooled population of spiders was recorded in untreated control with 4.17 and 4.33 spiders per five plants and followed by *Bacillus thuringiensis* @ 2.0 gm per liter of water. The next treatments in order of spiders population were neem oil (1500 ppm) @ 5.0 ml per litre of water, Emamectin benzoate 5% SG @ 0.5 gm per liter of water, Indoxacarb 14.5 SC@ 1.0 ml per liter of water, spinosad 45% SC @ 0.3 ml per liter of water, Profenophos 50EC @ 2.0ml per liter of water, Lambda- cyhalothrin @ 1.0 per liter of water and Quinalphos 20EC @ 2.0 ml per of water plants, respectively. The most harmful treatment was Quinalphos 20EC @ 2.0 ml per of water with spiders population of 2.17, 1.67, 1.41, 1.17,0.83, 0.17, 0.00 and 0.00 after seven and fourteen days of third spray

The effect of different treatments on spiders' population was recorded at seven and fourteen days after three spraying. Among all the biopesticides and newer insecticides treatments the maximum adults population of spiders was recorded with *Bacillus thuringiensis* @ 2.0 gm per liter of water, neem oil (1500 ppm) @ 5.0 ml per litre of water, Emamectin benzoate 5% SG @ 0.5 gm per liter of water, Indoxacarb 14.5 SC@ 1.0 ml per liter of water, spinosad 45% SC @ 0.3 ml per liter of water, Profenophos 50EC @ 2.0ml per liter of water, Lambda- cyhalothrin @ 1.0 per liter of water and Quinalphos 20EC @ 2.0 ml per of water plants, respectively. The lowest population was recorded in the treatment Quinalphos 20EC @ 2.0 ml per of water. The treatments, *Bacillus thuringiensis* @ 2.0 gm per liter of water and neem oil (1500 ppm) @ 5.00 ml per liter water were found safe against spiders population.

The present findings are supported by Tiwari *et al.* (2011) who reported that neem based pesticides were found relatively less harmful to the spiders. The present findings are in agreement with Sahana and Tayde (2017) ^[9] who found that population of spiders in different treatments was uniform and indicating the safety of all treatments to the spiders. The present findings are supported by.

Conclusion

The maximum population of spiders with After seven and fourteen days of second spray, among all the treatments the maximum pooled population of spiders was recorded in untreated control with 2.00 and 3.83 spiders per five plants and followed by *Bacillus thuringiensis* @ 2.0 gm per liter of water, neem oil (1500 ppm) @ 5.0 ml per litre of water, Emamectin benzoate 5% SG @ 0.5 gm per liter of water, Indoxacarb 14.5 SC@ 1.0 ml per liter of water, spinosad 45% SC @ 0.3 ml per liter of water, Profenophos 50EC @ 2.0ml per liter of water, Lambda- cyhalothrin @ 1.0 per liter of water and Quinalphos 20EC @ 2.0 ml per of water plants, respectively. The most harmful treatment was Quinalphos 20EC @ 2.0 ml per of water with spiders population of 2.67, 2.33, 2.17, 1.83, 1.67 0.67, 0.33 and 0.50 spiders per five plants, respectively. After seven days of spray the minimum population of spiders was found in treatment Quinalphos 20EC @ 2.0 ml per of water plants water with 0.50 spiders per five plants. the maximum adults population of spiders was

recorded with *Bacillus thuringiensis* @ 2.0 gm per liter of water, neem oil (1500 ppm) @ 5.0 ml per litre of water, Emamectin benzoate 5% SG @ 0.5 gm per liter of water, Indoxacarb 14.5 SC@ 1.0 ml per liter of water, spinosad 45% SC @ 0.3 ml per liter of water, Profenophos 50EC @ 2.0ml per liter of water, Lambda- cyhalothrin @ 1.0 per liter of water and Quinalphos 20EC @ 2.0 ml per of water plants, respectively. The lowest population was recorded in the treatment Quinalphos 20EC @ 2.0 ml per of water. The treatments, *Bacillus thuringiensis* @ 2.0 gm per liter of water and neem oil (1500 ppm) @ 5.00 ml per liter water were found safe against spiders population.

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