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Bio-efficacy of different bio-pesticides and insecticide against thrips (*Scirtothrips dorsalis* Hood) on chilli crop

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Abstract
Population fluctuation of thrips studies on chilli during *kharif* 2022-23 and 2023-24, at Student's Instructional Farm (SIF) of the Department of Agronomy, C. S. Azad University of Agriculture and Technology, Kanpur Uttar Pradesh. The experimental result revealed that treatment Imidacloprid 17.8 SL @ 0.2 ml/l with 84.69 percent reduction over control (PROC) proved best among all treatments in 3rd days after 1st and 2nd spray and also with minimum population at 7th and 10th days after spray. The second best treatment was Acetamiprid 20 SP @ 3 g/l) and followed by Spinosad 45 SC 0.2 ml/l, Thiamethoxam 25 WG @ 0.1 ml/l. After these treatments Neem Oil 1500 ppm, *Beauveria bassiana* $2x10^9$ spore/ml @ 5 ml/l and *Metarhizium anisopliae* $2x10^9$ spore/ml @ 5 ml/l were effective in relation to reduce the population of thrips. In this experiment we observed that the Imidacloprid proved best to manage the thrips population on chilli crop.

Keywords: *Scirtothrips dorsalis*, imidacloprid, bio-pesticides, chilli

1. Introduction
Chilli (*Capsicum annuum* L.) is one of the most important commercial vegetable crop which grown in India and many parts of the world. It introduced in India by the Portuguese in the 17th century. The area under chilli cultivation in India is 8.72 lakh hectares with estimated annual production of 25.97 lakh tonnes with 2978 kg/ha annual productivity. Andhra Pradesh is the largest producer of chilli in year 2023-24 among other states across India, while the Uttar Pradesh has ranked 12th with 17898 tons production per year. (Anonymous, 2023-24) [1]. After the tomato, it is the second most important solanaceous vegetable crop in the world. Chillies are mainly farmed for vegetables, spices, and high-value processed foods. The thrips *Scirtothrips dorsalis* Hood is the most serious and important polyphagous pest of the nursery to the last chilli harvest (Dey *et al.*, 2001; Hoddle *et al*., 2008) [7, 4]. *Scirtothrips dorsalis* is also responsible for causing indirect loss by transmitting several plant viruses; chilli leaf curl virus (CLCV), capsicum chlorosis virus (CaCV), tobacco streak virus (TSV), groundnut fan-spot virus, groundnut yellow spot virus, groundnut bud necrosis virus (PBNV) and melon yellow spot virus. The losses caused by viruses in the chilli crop ranged from 20-50% and may reach up to 80 100% in severe circumstances (Ramana *et al*., 2011) [5]. Chilli leaf curl virus (CLCV), locally known as 'Murda' disease is India's most destructive to chilli. Symptoms of CLCV show upward curling and puckering of leaves with size reduction. The prevalence and build-up of these insect pests of chilli crop is mostly governed by weather parameters like temperature, relative humidity and rainfall.

2. Materials and Methods
The field experiments were conducted during *kharif* 2022-23 and 2023-24, at Student's Instructional Farm (SIF) of the Department of Agronomy, C. S. Azad University of Agriculture and Technology, Kanpur Uttar Pradesh. Geographically, the district Kanpur Nagar falls in the subtropical alluvial tract of central plains of river Ganga-Yamuna situated between latitude 26^0 29' north and longitude $79^0$31 and $80^0$34' east. It is situated at elevation of 125.9 meter above mean sea level.

The chilli variety (G4) Bhagyalakshmi was planting in a plot size 10 x 10 m and spacing 50 x 50 cm during the 25th July 2022 and 26th July 2023 for both the years. For preparation of spray solution, the required quantity of commercial formulation is first mixed in small quantity of water thoroughly and then the remaining quantity of water is added to get the desired concentration of spray solution. The amount of commercial formulation required was computed on the basis of the following formula.

$N_1V_1 = N_2V_2$

Where:
N_1 = Concentration of Commercial formulation in % or gram.
V_1= Volume or amount of Commercial formulation required in ml or gram.
N_2= Desired concentration of spray fluid in %.
V_2= Volume or amount of spray fluid required in ml.

First spraying was done on 6th September 2022 and 4th September 2023 in the evening hours at the time of infestation which is coincide with Vegetative stage of chilli. A high volume hand compression knapsack sprayer will be used for spraying of different Treatments the sprayer will be calibrated to the uniform spray of fluid solution of Treatments in each plot except control plot. Spraying will be done during evening in such a way to give uniform spray on foliage and to avoid drift and photo oxidation of the bio-pesticides. Treatments will be applied as foliar spray at 30th and 45th day after transplanting (DAT). After transplanting of crop when population of thrips per five plant (Economic Threshold Level-5 thrips/plant) seen in the experiment. Two spraying were made and data was recorded after 3rd, 7th and 10th days of each spraying and presented in tables. The observations were recorded on the population of thrips of five randomly selected plants in each plot on one day before every spray which served as pre-treatment observation and the subsequent count were taken on 3rd, 7th, and 10th days after each spray (Post-treatment) and the observation on the thrips population was recorded during morning hours.

Table 1: Recommended dose of bio-pesticides and Insecticide for Thrips as spray

S. No.	Name of bio-pesticides & Insectides	Dose/liter water	Trade name
1.	Neem oil	2.5 ml/lit	Neem oil
2.	*Beauveria bassiana*	5 ml/lit	Green Beauveria
3.	*Metarhizium anisopliae*	5 ml/lit	Green Meta
4.	*Spinosad*	0.2-.3 ml/lit	Tracer
5.	Acetamiprid	3 gm/lit	Pride
6.	Imidacloprid	0.2 ml/lit	Confidence
7.	Thiamethoxam	0.1 gm/lit	Dhruvtara
8.	Untreated (Control)	-	-

3. Results and Discussion

Pooled data regarding the effect of different bio-pesticides and insecticides on the population of thrips on chilli crop for both the years 2022-23 and 2023-24 are presented in Table 4 and Fig., 1, 2 & 3. The results showed that all the bio-pesticides and insecticides were found to be significantly superior over control (Untreated) in reducing the population of thrips at 3rd, 7th and 10th days after 1st and 2nd spray of different treatments. The data indicate that treatment Imidacloprid 17.8 SL @ 0.2 ml/l with 84.69 percent reduction over control (PROC) proved best among all treatments in 3rd days after 1st and 2nd spray. The second best treatment was Acetamiprid 20 SP @ 3 g/l 80.19 PROC) and followed by Spinosad 45 SC 0.2 ml/l (67.98 PROC), Thiamethoxam 25 WG @ 0.1 ml/l (64.12 PROC). After these treatments Neem Oil 1500 ppm, *Beauveria bassiana* $2x10^9$ spore/ml @ 5 ml/l and *Metarhizium anisopliae* $2x10^9$ spore/ml @ 5 ml/l (56.37, 54.44 and 50.87 PROC respectively) were effective in relation to reduce the population of thrips.

The Imidacloprid 17.8 SL @ 0.2 ml/l with 78.81 percent reduction over control (PROC) proved best among all treatments in 7th days after 1st and 2nd spray. The second best treatment was Acetamiprid 20 SP @ 3 g/l 74.12 PROC) and followed by Spinosad 45 SC 0.2 ml/l (64.52%), Thiamethoxam 25 WG @ 0.1 ml/l (61.66%). After these treatments Neem Oil 1500 ppm, *Beauveria bassiana* $2x10^9$ spore/ml @ 5 ml/l and *Metarhizium anisopliae* $2x10^9$ spore/ml @ 5 ml/l (50.98, 48.47 and 45.60 PROC respectively) were effective in relation to reduce the population of thrips.

The Imidacloprid 17.8 SL @ 0.2 ml/l, 71.24 percent reduction over control (PROC) proved best among all treatments in 10th days after 1st and 2nd spray. The second best treatment was Acetamiprid 20 SP @ 3 g/l, 67.82 PROC) and followed by Spinosad 45 SC 0.2 ml/l (59.52 PROC), Thiamethoxam 25 WG @ 0.1 ml/l (57.93 PROC). And the treatments Neem Oil 1500 ppm, *Beauveria bassiana* $2x10^9$ spore/ml @ 5 ml/l and *Metarhizium anisopliae* $2x10^9$ spore/ml @ 5 ml/l (54.96, 50.50 and 48.09 PROC respectively) were effective in relation to mitigate the population of thrips.

Table 2: Effect of different bio-pesticides and insecticide on the population of thrips on chilli crop after 3rd, 7th and 10th DAS during 2022-23.

S. N.	Treatments	Dose (in gm or ml)	Thrips population per plant											
			3 Days after spray (DAS)				7 Days after spray (DAS)				10 Days after spray (DAS)			
			1st	2nd	Mean	PROC	1st	2nd	Mean	PROC	1st	2nd	Mean	PROC
1.	Neem Oil 1500 ppm,	2.5 ml/lit	2.07 (3.26)	2.07 (3.26)	2.07 (3.26)	54.91	2.10 (3.40)	2.10 (3.40)	2.10 (3.40)	48.40	2.01 (3.02)	2.01 (3.02)	2.01 (3.02)	54.54
2.	*Beauveria bassiana* 2x10^9 spore/ml	5 ml/lit	2.09 (3.37)	2.09 (3.37)	2.09 (3.37)	53.38	2.14 (3.58)	2.14 (3.58)	2.14 (3.58)	45.67	2.09 (3.35)	2.09 (3.35)	2.09 (3.35)	52.41
3.	*Metarhizium anisopliae* 2x10^9 spore/ml	5 ml/lit	2.14 (3.58)	2.14 (3.58)	2.14 (3.58)	50.48	2.19 (3.80)	2.19 (3.80)	2.19 (3.80)	42.33	2.14 (3.58)	2.14 (3.57)	2.14 (3.58)	49.14
4.	Spinosad 45 SC	0.2-.3 ml/lit	1.84 (2.38)	1.84 (2.38)	1.84 (2.38)	67.08	1.85 (2.42)	1.85 (2.42)	1.85 (2.42)	63.27	1.93 (2.73)	1.93 (2.73)	1.93 (2.73)	61.22
5.	Acetamiprid 20 SP	3 gm/lit	1.54 (1.51)	1.60 (1.56)	1.57 (1.54)	78.83	1.75 (2.05)	1.60 (1.55)	1.68 (1.80)	72.68	1.81 (2.28)	1.77 (2.14)	1.79 (2.21)	68.60
6.	Imidacloprid 17.8 SL	0.2 ml/lit ml	1.39 (0.94)	1.47 (1.17)	1.43 (1.06)	85.47	1.70 (1.89)	1.51 (1.27)	1.61 (1.58)	76.02	1.77 (2.13)	1.66 (1.80)	1.72 (1.97)	72.01
7.	Thiamethoxam 25 WG	0.1 gm/lit	1.91 (2.66)	1.91 (2.66)	1.91 (2.66)	63.20	1.90 (2.60)	1.90 (2.60)	1.90 (2.60)	60.54	1.98 (2.91)	1.98 (2.91)	1.98 (2.91)	58.66
8.	Untreated (Control).		2.83 (7.02)	2.90 (7.44)	2.87 (7.23)	-	2.65 (6.02)	2.86 (7.16)	2.76 (6.59)	-	2.86 (7.17)	2.81 (6.90)	2.84 (7.04)	-
SE (m) ±					0.047				0.025				0.032	
C.D. at 5%					0.140				0.076				0.103	

Figures in parenthesis are √x+0.5 transformed value

Table 3: Effect of different bio-pesticides and insecticide on the population of thrips on chilli crop after 3rd, 7th and 10th DAS during 2023-24

S. N.	Treatments	Dose (in gm or ml)	Thrips population per plant											
			3 Days after spray (DAS)				7 Days after spray (DAS)				10 Days after spray (DAS)			
			1st	2nd	Mean	PROC	1st	2nd	Mean	PROC	1st	2nd	Mean	PROC
1.	Neem Oil 1500 ppm,	2.5 ml/lit	2.01 (3.04)	2.01 (3.05)	2.01 (3.05)	59.17	2.10 (3.43)	2.03 (3.11)	2.07 (3.27)	53.55	2.02 (3.08)	1.99 (2.95)	2.01 (3.02)	52.81
2.	*Beauveria bassiana* 2x10^9 spore/ml	5 ml/lit	2.05 (3.20)	2.06 (3.24)	2.06 (3.22)	56.89	2.12 (3.50)	2.09 (3.35)	2.11 (3.43)	51.27	2.08 (3.31)	2.07 (3.27)	2.08 (3.29)	48.59
3.	*Metarhizium anisopliae* 2x10^9 spore/ml	5 ml/lit	2.10 (3.40)	2.16 (3.66)	2.13 (3.53)	52.74	2.19 (3.80)	2.10 (3.40)	2.15 (3.60)	48.86	2.11 (3.46)	2.08 (3.31)	2.10 (3.39)	47.03
4.	Spinosad 45 SC	0.2-.3 ml/lit	1.81 (2.26)	1.80 (2.24)	1.81 (2.25)	69.87	1.85 (2.42)	1.84 (2.40)	1.85 (2.41)	65.76	1.94 (2.75)	1.91 (2.64)	1.93 (2.70)	57.81
5.	Acetamiprid 20 SP	3 gm/lit	1.57 (1.48)	1.57 (1.46)	1.57 (1.32)	82.32	1.64 (1.71)	1.65 (1.72)	1.65 (1.72)	75.56	1.73 (2.02)	1.79 (2.19)	1.76 (2.11)	67.03
6.	Imidacloprid 17.8 SL	0.2 ml/lit ml	1.46 (1.14)	1.47 (1.18)	1.47 (1.16)	84.47	1.52 (1.32)	1.56 (1.43)	1.54 (1.38)	80.39	1.69 (1.85)	1.71 (1.93)	1.70 (1.89)	70.46
7.	Thiamethoxam 25 WG	0.1 gm/lit	1.90 (2.62)	1.85 (2.44)	1.88 (2.53)	66.13	1.89 (2.58)	1.91 (2.66)	1.90 (2.62)	62.78	1.95 (2.82)	1.95 (2.82)	1.95 (2.82)	55.93
8.	Untreated (Control).		2.93 (7.56)	2.89 (7.38)	2.91 (7.47)	-	2.82 (6.93)	2.85 (7.15)	2.84 (7.04)	-	2.72 (6.39)	2.72 (6.40)	2.72 (6.40)	-
SE (m) ±					0.038				0.042				0.035	
C.D. at 5%					0.118				0.131				0.109	

Figures in parenthesis are √x+0.5 transformed value

Table 4: Effect of different bio-pesticides and insecticides on the population of thrips on chilli crop after 3rd, 7th and 10th DAS in both years during 2022-23 and 2023-24 (Pooled data)

S. N.	Treatments	Dose in gm or ml	Thrips Population per plant																	
			3 Days after spray (DAS)						7 Days after spray (DAS)						10 Days after spray (DAS)					
			Mean			PROC			Mean			PROC			Mean			PROC		
			2022-23	2023-24	Over all Mean	2022-23	2023-24	Mean PROC	2022-23	2023-24	Over all Mean	2022-23	2023-24	Mean PROC	2022-23	2023-24	Over all Mean	2022-23	2023-24	Mean PROC
1.	Neem Oil 1500 ppm,	2.5 ml/lit	2.07 (3.26)	2.01 (3.05)	2.04 (3.16)	53.56	59.17	56.37	2.10 (3.40	2.07 (3.27)	2.09 (3.34)	48.40	53.55	50.98	2.01 (3.02)	2.01 (3.02)	2.01 (3.02)	57.10	52.81	54.96
2.	*Beauveria bassiana* 2x10^9 spore/ml	5 ml/lit	2.09 (3.37)	2.06 (3.22)	2.08 (3.30)	51.99	56.89	54.44	2.14 (3.58	2.11 (3.43)	2.13 (3.51)	45.67	51.27	48.47	2.09 (3.35)	2.08 (3.29)	2.09 (3.32)	52.41	48.59	50.50
3.	*Metarhizium anisopliae* 2x10^9 spore/ml	5 ml/lit	2.14 (3.58)	2.13 (3.53)	2.14 (3.56)	49.00	52.74	50.87	2.19 (3.80	2.15 (3.60)	2.17 (3.70)	42.33	48.86	45.60	2.14 (3.58)	2.10 (3.39)	2.12 (3.49)	49.14	47.03	48.09
4.	Spinosad 45 SC	0.2-.3 ml/lit	1.84 (2.38)	1.81 (2.25)	1.83 (2.32)	66.09	69.87	67.98	1.85 (2.42	1.85 (2.41)	1.85 (2.42)	63.27	65.76	64.52	1.93 (2.73)	1.93 (2.70)	1.93 (2.72)	61.22	57.81	59.52
5.	Acetamiprid 20 SP	3 gm/lit	1.57 (1.54)	1.57 (1.32)	1.57 (1.43)	78.06	82.32	80.19	1.68 (1.80	1.65 (1.72)	1.67 (1.76)	72.68	75.56	74.12	1.79 (2.21)	1.76 (2.11)	1.78 (2.16)	68.60	67.03	67.82
6.	Imidacloprid 17.8 SL	0.2 ml/lit ml	1.43 (1.06)	1.47 (1.16)	1.45 (1.11)	84.90	84.47	84.69	1.61 (1.58	1.54 (1.38)	1.58 (1.48)	76.02	80.39	78.21	1.72 (1.97)	1.70 (1.89)	1.71 (1.93)	72.01	70.46	71.24
7.	Thiamethoxam 25 WG	0.1 gm/lit	1.91 (2.66)	1.88 (2.53)	1.90 (2.60)	62.10	66.13	64.12	1.90 (2.60	1.90 (2.62)	1.90 (2.61)	60.54	62.78	61.66	1.98 (2.91)	1.95 (2.82)	1.97 (2.87)	58.66	55.93	57.30
8.	Untreated (Control).	-	2.83 (7.02)	2.91 (7.47)	2.89 (7.35)				2.76 (6.59	2.84 (7.04)	2.80 (6.82)				2.84 (7.04)	2.72 (6.40)	2.78 (6.72)			
SE (m) ±					0.042						0.033						0.034			
C.D. at 5%					0.129						0.103						0.106			

Figures in parenthesis are √x+0.5 transformed value

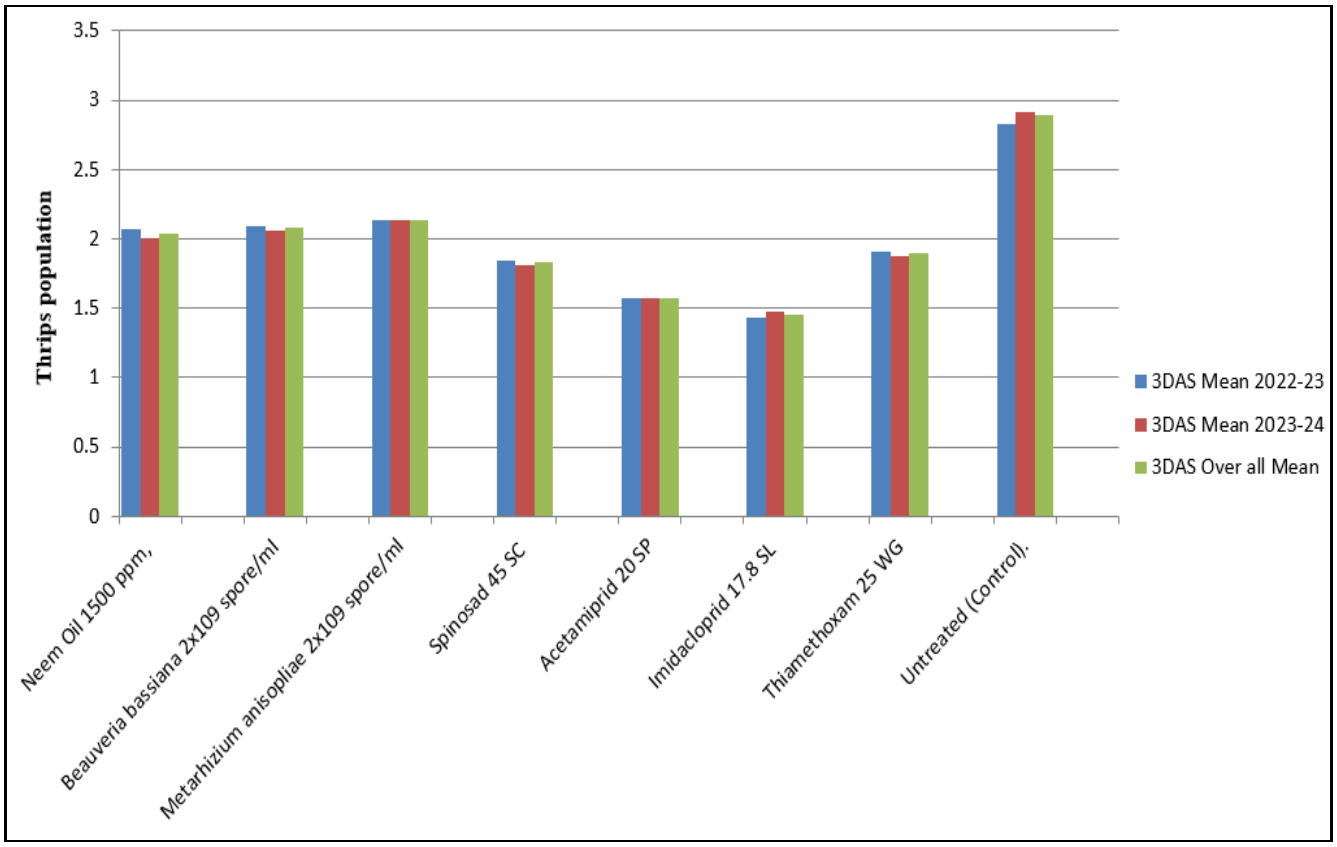

Fig 1: Effect of different bio-pesticides and insecticides on the population of thrips on chilli crop after 3rd DAS in both years during 2022-23 and 2023-24 (Pooled data)

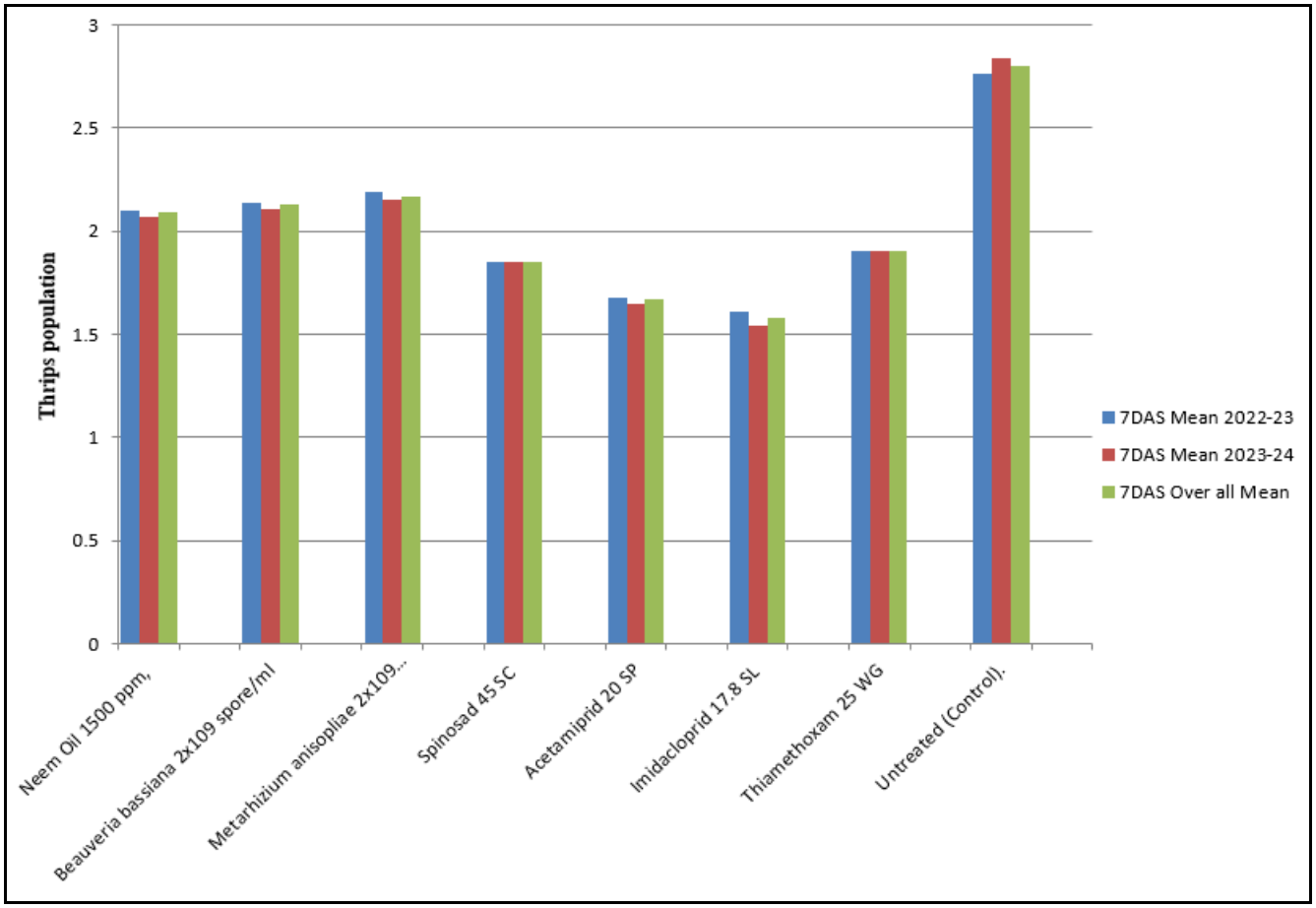

Fig 2: Effect of different bio-pesticides and insecticides on the population of thrips on chilli crop after 7th DAS in both years during 2022-23 and 2023-24 (Pooled data)

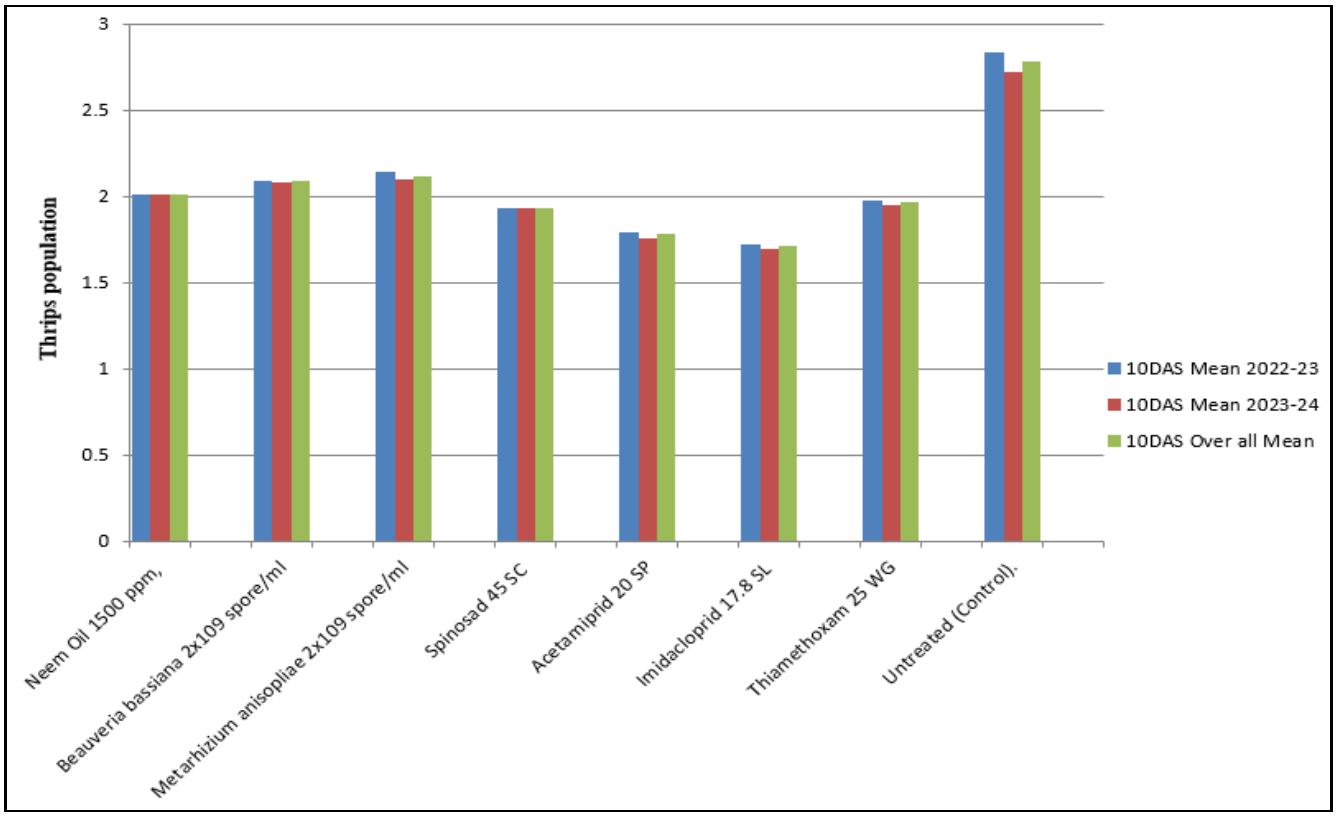

Fig 3: Effect of different bio-pesticides and insecticides on the population of thrips on chilli crop after 10th DAS in both years during 2022-23 and 2023-24 (Pooled data)

The results of present investigation corroborate with the results of Raut and Kumar (2024) [6] investigation was conducted at the research plot of the Department of Agricultural Entomology at Central Research Farm (CRF), Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj during the Kharif season of 2023-24 eight treatments, were evaluated against *Scirtothrips dorsalis*. Imidacloprid 17.8% SC 1 ml/lit, evaluated against chilli thrips (*Scirtothrips dorsalis*) among the insecticides proved to be most effective treatment. Ali *et al*., (2023) [2] studied that thrips are important pests of onion and the populations can develop very rapidly so it is necessary to control its population. The experiments were applied in the field to evaluate insecticide Acetamiprid, against Thrips tabaci on the onion field during 2023 season. The obtained results showed that, Acetamiprid effective to control population of thrips. Quratul *et al*., (2021) [3] studied that application of *Metarhizium anisopliae* was found effective to manage build-up of thrips population.

4. Conclusion

The present study concluded that the application of Imidacloprid 17.8 SL @ 0.2 ml/l was more effective in reduction of thrips population to obtain higher fruit yield of chilli than other bio-pesticides and Insecticides spray. Hence, Imidacloprid 17.8 SL @ 0.2 ml/l can suitably be included in Integrated Pest Management of sucking insect pests like thrips in chilli.

5. Acknowledgements

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