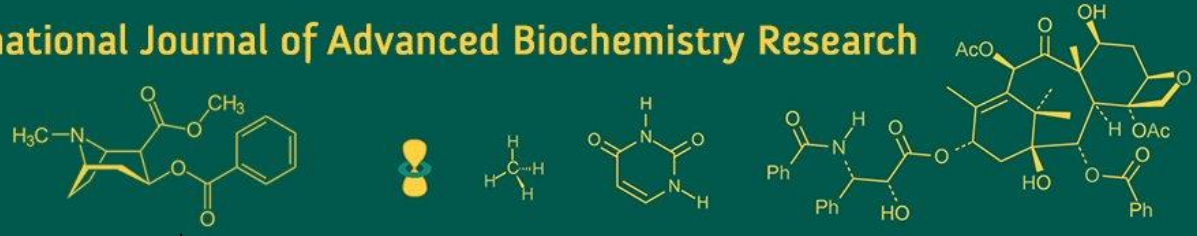
International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
IJABR 2024; SP-8(7): 947-952
www.biochemjournal.com
Received: 10-06-2024
Accepted: 15-07-2024

Basavaraj S Kalmath
Associate Professor of Entomology, Department of Entomology, College of Agriculture, Raichur, Karnataka, India

Shivaleela Gouda
Associate Professor of Entomology, Department of Entomology, College of Agriculture, Raichur, Karnataka, India

Sushila Nadagoud
Professor of Entomology, Department of Entomology, College of Agriculture, Raichur, Karnataka, India

Kavanashree K
Field Scientist, M/s Corteva Agriscience India Private Limited, The V-Ascendas, Atria Block, 12 th Floor, Plot No 17, Software units Layout, Madhapur Hyderabad, Telangana, India

Dr. Hadimani DK
Assistant Professor of Sericulture, Department of Entomology, College of Agriculture, Raichur, Karnataka, India

Sanganna Sajjanar
Assistant Professor, Department of Entomology, College of Agriculture, Raichur, Karnataka, India

Corresponding Author:
Basavaraj S Kalmath
Associate Professor of Entomology, Department of Entomology, College of Agriculture, Raichur, Karnataka, India

Evaluation of bio-efficacy of spinetoram 25% WG against cotton thrips *Thrips tabaci*

Basavaraj S Kalmath, Shivaleela Gouda, Sushila Nadagoud, Kavanashree K, Dr. Hadimani DK and Sanganna Sajjanar

DOI: https://doi.org/10.33545/26174693.2024.v8.i7Sl.2760

Abstract
Thrips *Thrips tabaci* is one of the important insect pests of cotton crop, causing severe damage in the early stage of the crop and is developed resistance to most of insecticides. In the present study, novel insecticides and formulation was evaluated against *T.tabaci.* The results indicated that, the significantly lowest thrips population was noticed in the treatment Spinetoram 25% WG @ 45 g a.i./ha (4.53 thrips/leaf) fourteen days after the first spray, which was on par with the treatment Spinetoram 25% WG @ 36 g a.i./ha (4.58 thrips/leaf). Percent reduction over control was significantly highest in the treatment Spinetoram 25% WG @ 45 g a.i./ha with 72.71. Similarly, the lowest thrips populations were recorded in the treatment Spinetoram 25% WG @ 45 g a.i./ha with 0.88 thrips/leaf fourteen days after the second spray. Significant maximum percent reduction over control was exhibited in the treatments with Spinetoram 25% WG @ 45 g a.i./ha with 92.16 percent. The maximum yield was recorded in the treatment of Spinetoram 25% WG @ 45 g a.i./ha (22.50 q/ha), which was on par with the treatment Spinetoram 25% WG @ 36 g a.i./ha (21.75q/ha). The Spinetoram 25% WG did not affect natural enemies in cotton and did not cause phytotoxicity symptoms even when sprayed @ 72 g a.i./ha

Keywords: Bio-efficacy, phytotoxicity, natural enemies, spinetoram 25% WG

Introduction
Cotton (*Gossypium* sp.) is being called as "King of Fibre" belonging to the family Malvaceae. It significantly supports agricultural income, export revenues, and the creation of jobs in both agriculture and industry. Cotton is cultivated mainly for lint fibre, which is its primary value, but it also produces various by-products. Additional benefits are provided by cottonseed-based products, which include animal feed and a variety of oil-based commodities. According to the International Cotton Advisory Committee, the production of cotton in the world during the year 2022-23 was projected to 24.51 million tonnes (1441 lakh bales), which is 2.8% lesser in comparison to the previous year's production of 25.18 million tonnes (1481 lakh bales). Global cotton export was projected at 8.98 million tonnes (528 lakh bales). Global cotton import is estimated at 8.98 million tonnes (528 lakh bales). Global ending stocks is estimated at 20.14 million tonnes (1184 lakh bales) (https://texmin.nic.in). In the year 2021-22 the area under cotton production was 32.10 million hectares, production and productivity accounted for 257.71 million bales and 1370 kg/ha respectively. In India, cotton is one of the most important commercial crops cultivated in India and accounts for around 23% of the total global cotton production. It plays a major role in sustaining the livelihood of an estimated 6 million cotton farmers and 40-50 million people engaged in related activities such as cotton processing and trade. India got 1st place in the world in cotton acreage with 130.61 lakh hectares area under cotton cultivation i.e. around 40% of the world area of 324.16 lakh hectares. Approximately 67% of India's cotton is produced in rain-fed areas and 33% on irrigated lands. In terms of productivity, India is on 39 th rank with a yield of 447 kg/ha(https://texmin.nic.in).

There are several constraints in the production and productivity of cotton in India, of which insect pests and diseases are the predominant ones. Pests and diseases are estimated to cause 60% losses in cotton production throughout the world. This Crop is infested by various kinds of insect pests at different stages of growth (Uthamasamy, 1994; Sahito *et al.*, 2017) [9, 8], 148

insect pests have been recorded on this crop, out of which 17 species were found major (Abbas, 2001) [1]. Bollworms and sucking pests are important pests, however, bollworms are controlled by transgenic Bt cotton. Among sucking pests, thrips *Trips tabaci* have been causing severe damage to crops at an early stage of the crop (20-60 days old crop). There are several management practices for the control of thrips such as cultural, mechanical, physical, biological, and chemical components. Among them, chemical control is the most commonly used method, because it controls the pests quickly and is easily available. Most of the insects already developed resistance lost their effectiveness, few caused a resurgence and are highly toxic to non-target organisms. In this context, the identification of a novel insecticide, which is having unique mode of action, green-labeled, and effectively controls the pests is the need of the hour. With this background, the present study aimed to evaluate Spinetoram 25% WG against thrips in the cotton ecosystem and standardized the dosage, further, we assessed the effectiveness of the chemical against natural enemies, and its phytotoxicity experiments were conducted.

Materials and Methods

Bio-efficacy of Spinetoram 25% WG against thrips *T. tabaci*

Evaluation of Spinetoram 25% WG against thrips *T. tabaci* in cotton was undertaken in an experimental block at Main Agricultural Research Station, Raichur during *Kharif* 2022-23. The experiment was laid out in a randomized block design (RBD) with four replications. The test molecule, Spinetoram 25% WG was tested at four different dosages *viz*., 24, 30, 36, and 45 g. a. i./ha for its efficacy against thrips *Thrips tabaci* and at 72 g.a.i. per hectare for its phytotoxicity evaluation. This was compared with three standard checks *viz.*, Fipronil 5.00 SC and Imidacloprid 17.80% SL along with an untreated control against *T. tabaci*. Treatments were imposed two times based on pest population build-up (above ETL). All the agronomic practices were followed as per the recommended package of practices of UAS Raichur. Observations were recorded on the number of thrips *T. tabaci* per leaves on the top five leaves of randomly selected and tagged seven plants in each plot. The observations were taken one day prior to treatment imposition and 1,3, 7, 10 and 14 days after each treatment imposition. The data collected on thrips were averaged and expressed on a per leaf basis. The natural enemies population was also recorded on tagged seven plants in a plot, one day before, 1, 3, 5, 7, and 10 days ten days after each spray.

Seed cotton yield

The total seed cotton yield was recorded separately from each plot at each picking and finally, the total yield was computed by adding the seed cotton yield from all pickings and was expressed per hectare basis. The yield data collected from each plot was extrapolated on a hectare basis.

Weather parameters

Weather factors *viz*., maximum temperature and minimum temperature, relative humidity and rainfall data during the cropping period were obtained from the automatic weather station, installed at MARS, Raichur.

Statistical analysis

The data generated on the thrips along with natural enemies at pre and post-count from seven randomly selected plants were averaged to per plant basis. Further, data were subjected to statistical analysis after transforming them to $\sqrt{x+1}$. The data collected were subjected to statistical analysis by single-factor ANOVA.

Phytotoxicity

The extent of phytotoxicity of Spinetoram 25% WG was recorded on cotton plant on 1, 3, 5, 7 and 10 days after application in all treatments. The phytotoxicity observations were recorded for A) Leaf injury on tips/ surface B) Necrosis C) Epinasty D) Hyponasty E) Vein clearing F) Wilting. The following phytotoxic rating scale was followed in this trail.

Rating	Phytotoxicity%
0	No phytotoxicity
1	1 – 10
2	11 – 20
3	21 – 30
4	31 – 40
5	41 – 50
6	51 – 60
7	61 – 70
8	71 – 80
9	81 – 90
10	91 – 100

Results and Discussion

Pre-treatment count on number of thrips *Thrips tabaci* were non-significant among the treatments indicating the uniformity in the incidence of the pests in the experimental plots.

Bio-efficacy of Spinetoram 25% WG against thrips *Thrips tabaci* (After first spray)

The population of thrips recorded at different time intervals during Kharif 2022-23 have been presented in Table 1. The thrips population before spray was uniform in all the treatments ranging from 15.97 to 16.74 thrips/leaf and there was no significant difference among the treatments indicating the uniformity in the incidence of the pests in the experimental plots. One day after the first spray, the treatment Spinetoram 25% WG @ 45 g a.i./ha recorded the lowest thrips population 6.71 thrips/leaf, this was on par with the treatment Spinetoram 25% WG @ 36 a.i./ha (6.77 thrips/leaf). The remaining treatments recorded thrips population ranging from 8.08 to 10.41 thrips/leaf. The thrips population was recorded highest in the treatment untreated control with 15.07 thrips/leaf. Percent reduction of thrips over control was found to be highest in the treatment Spinetoram 25% WG @ 45 g a.i./ha with 55.47 percent, which was on par with the treatment Spinetoram 25% WG @ 36 g a.i./ha (55.07 percent). Reduction of *T. tabaci* population over control was ranged from 30.92 to 46.38 percent. A similar trend was observed three, seven, and ten days after the first spray (Table 1).

Fourteen days after the first spray, significantly lowest thrips population was recorded in the treatment Spinetoram 25% WG @ 45 g a.i./ha with 4.53 thrips/leaf, which was on par with the treatment Spinetoram 25% WG @ 36 g a.i./ha

(4.58 thrips/leaf). Next best treatment was Spinetoram 25% WG @ 30 g a.i./ha, which recorded 5.85 thrips/leaf. This was followed by the treatment Spinetoram 25% WG @ 24 g a.i./ha and Fipronil 5.00% SC, recorded thrips population of 7.15 and 7.18 thrips/leaf respectively. Thrips population recorded in the treatment Imidacloprid 17.8% SL was 8.53 thrips/leaf. Significantly highest thrips population was noticed in the untreated control treatment with 16.60 thrips/leaf. Similarly, percent reduction over control was significantly highest in the treatment with Spinetoram 25% WG @ 45 g a.i./ha 72.71 percent, which was on par with the treatment Spinetoram 25% WG @ 36 g a.i./ha (72.41 percent). The remaining treatment percent reduction of the thrips population was ranged from 48.61 to 64.76 percent (Table 1).

Bio-efficacy of Spinetoram25Spinetoram 25% WG against thrips *Thrips tabaci* (After the second spray)

The thrips population recorded at different time intervals after the second spray has been presented in Table 2. One day after the second spray, the lowest thrips population was recorded in the treatment of Spinetoram 25% WG @ 45 g a.i./ha with 2.78 thrips/leaf, this was on par with the treatment Spinetoram 25% WG @ 36 g a.i./ha (2.88 thrips/leaf). This was followed by the treatments of Spinetoram 25% WG @ 30 g a.i./ha (4.1 thrips/leaf) and Fipronil 5.00% SC (5.4thrips/leaf). Significantly highest thrips population was recorded in the untreated control treatment with 15.15 thrips/leaf. Percent reduction of thrips over control was significantly highest in the treatment Spinetoram 25% WG @ 45 g a.i./ha (81.65 percent) and Spinetoram 25% WG @ 36 g a.i./ha (80.99 percent), which were on par with each other. The remaining treatment recorded a percent reduction over control ranging from 55.45 percent to 72.94 percent. A similar trend was observed three, seven, and ten days after the second spray (Table 2).

Significantly, the lowest thrips populations was recorded in the treatment Spinetoram 25% WG @ 45 g a.i./ha with 1.38 thrips/leaf fourteen days after the second spray, which was on par with the treatment Spinetoram 25% WG @ 36 g a.i./ha (1.45 thrips/leaf). This was followed by the treatment Spinetoram 25% WG @ 30 g a.i./ha (2.70thrips/leaf), which was at par with the treatment Spinetoram 25% WG @ 24 g a.i./ha (3.73 thrips/lea). Significantly, the lowest thrips populations were noticed in the treatment Imidacloprid 17.8% SL (5.15 thrips/leaf). Significantly highest thrips population was observed in the untreated control with 11.75 thrips/leaf. Percent reduction over control was maximum in the treatment with Spinetoram 25% WG @ 45 g a.i./ha (88.26 percent) and Spinetoram 25% WG @ 36 g a.i./ha (87.66 percent), which are at par with each other. This was followed by the treatment Spinetoram 25% WG @ 30 g a.i./ha (77.02 percent) and Spinetoram 25% WG @ 24 g a.i./ha (68.26 percent). Significantly, a minimum percent reduction over control was observed in the treatment of Imidacloprid 17.80% SL (56.17 percent) (Table 2).

Cotton yield at harvest

Significantly highest yield was recorded in the treatment of Spinetoram 25% WG @ 45 g a.i./ha (22.50 q/ha), which was on par with the treatment Spinetoram 25% WG @ 36 g a.i./ha (21.75q/ha). The remaining treatments recorded yield ranged from 15.00 to 19.00 q/ha. Significantly lowest yield was recorded in the treatment untreated control with 12.00 q/ha (Table 2).

Effect of Spinetoram 25% WG on natural enemies in cotton

The populations of natural enemies prevailing in the crop ecosystem were recorded before the first spray of treatments and 1,3,5,7 and 10 days after each spray. The population recorded for coccinellids and spiders has been presented in Tables 3 and 4. The population of natural enemies was uniform in all the treatments before imposition of the chemical spray population but after the treatment imposition, the natural enemy population declined to some extent as compared to untreated control. There was no significant difference among the treatments including untreated control seven days after each application

Phytotoxicity of Spinetoram 25% WG on cotton

The crop was visually observed for the phytotoxic symptoms sprayed with Spinetoram 25% WG and other treatments at the tested doses at different time intervals. None of the Phytotoxicity symptoms like necrosis, epinasty, hyponasty, leaf injury on tips/ leaf surface, wilting, and vein clearing were observed even with the application of the highest dose of Spinetoram 25% WG @ 72 g.a. i./ha.

The present study conformed with the reports of Kumar *et al* (2017) [5] who, reported the evaluation of Spinetoram 12 SC for the control of *S. litura* in onion. Results indicated that Spinetoram 12 SC was significantly effective at 36 and 45 g a.i/ha when sprayed thrice at 15-day intervals in minimizing leaf damage on onion plants and in increasing the bulb yield. Higher dosages of Spinetoram did not show any phytotoxic symptoms on onion plants. Similarly, Ramalakshmi *et al*. (2020) [7], assessed the efficacy of different insecticides for the management of cotton thrips. Among the different tested insecticides, Fipronil 5% SC@ 50g.a.i/ha had shown 76.70 per cent reduction of thrips, followed by Fipronil 80% WG@ 50g.a.i/ha, Acephate 75% SP@ 750g.a.i/ha and Imidacloprid 70% WG @ 21 g.a.i/ha had shown 74.5, 71.6 and 69.0per cent reduction over the control respectively ten days after treatment. It has also recorded the highest yield of 13.5 q/ha when compared to other treatments.

The results are also in line with the reports of Kkadan *et al* (2020) [4] who, evaluated the Spinetoram for control of lepidopteran and thrips in the field and nursery. The effectiveness of Spinetoram-based solution (0.12%) was 100% against *S. exigua* and 95% to *Scirtothrips* sp. 15 days after treatment. The severity of *Scirtothrips* sp. was 5.3% in the Spinetoram (0.12%) treatment, while it was 80% in standard check chlorpyrifos (0.4%) and 96% in untreated control at 15 days after treatment. Spinetoram at 12 g a.i./ha was found significantly effective against *S. semicanella* in Eucalyptus spp. Spinetoram has broad insecticidal spectrum activity and reliable indices for integrated pest management strategies against major pests of *Acacia crassicarpa* and Eucalyptus spp. Similarly, the performance of organic products such as Entrust (spinosad), Azera (pyrethrin and azadirachtin), PyGanic (pyrethrin), and Neemix (azadirachtin) were envaulted against different insect pests such as thrips, stinkbugs, cucumber beetles and fruit borers, the result revealed that, an overall reduction in pest infestations by 73.90%, 61.70%, 48.60% and 46.10%, respectively (Dively *et al* 2020) [3].

The present study also in agreement with the report of Matharu and Tanwar (2020) [6], who evaluated, different insecticides Spinetoram 11.7 SC, Diafenthiuron 50 WP, and Thiamethoxam 25 WG against thrips on cotton crops. Results of the present study revealed that the lowest population of thrips i.e., 3.03 per leaf was recorded with the treatment of Spinetoram 11.7 SC followed by Diafenthiuron 50 WP and Thiamethoxam 25 WG with records of 8.70 and 12.07 thrips per leaf, respectively after 10 days of spray. Similarly, the highest yield of cotton (21.25 q/ha) and benefit-cost ratio (3.48) was observed the application of Spinetoram 11.7 SC. Similarly, Din *et al*. (2015) [2] evaluated different insecticides Tracer 240SC (Spinosad), Orthene 75SP (Acephate), Sanitox 40EC (Dimethoate), Pirate 360SC (Chlorfenapyr), Radiant125SC (Spinetoram), Mospilan 20SP (Acetamaprid) and Confidor 200SL (Imidacloprid) against thrips on cotton in field condition. Results showed that Tracer and Radiant were less effective (34.52 and 31.58% mortality) for 24 hours, but their efficacy increased after 72 hours (68.64 and 73.42% mortality) and recorded with maximum mortality at 168 hours (83.67 and 84.33%) among all the tested insecticides. Santox and Orthene were found as most effective at 24 hours (62.33 and 48.50% mortality), whereas their residual effect decreased gradually from 72 hours up to 168 hours against the population of thrips. The conclusions of our findings are that among the tested insecticides, Tracer 240SC and Radiant 125SC were more effective for the control of thrips on cotton crop.

Table 1: Effect of Spinetoram 25% WG against thrips (*T. tabaci*) after the first spray in cotton

Sl. No.	Treatment	Dosage (g. ai. /ha)	First spray										
			1 DBS	1 DAS	% Reduction over control	3 DAS	% Reduction over control	7 DAS	% Reduction over control	10DAS	% Reduction over control	14 DAS	% Reduction over control
T_1	Spinetoram 25% WG	24	16.23 (4.14) [a]	8.50 (2.91) [cd]	43.59	7.15 (2.67) [c]	49.51	5.75 (2.40) [c]	62.32	5.88 (2.42) [c]	61.92	7.15 (2.67) [c]	56.93
T_2	Spinetoram 25% WG	30	15.97 (4.12) [a]	8.08 (2.84) [d]	46.38	5.86 (2.42) [d]	58.62	4.48 (2.11) [d]	70.64	4.60 (2.14) [d]	70.21	5.85 (2.42) [d]	64.76
T_3	Spinetoram 25% WG	36	16.39 (4.16) [a]	6.77 (2.60) [e]	55.07	4.03 (2.01) [e]	71.54	3.04 (1.74) [e]	80.08	3.28 (1.81) [e]	78.76	4.58 (2.14) [e]	72.41
T_4	Spinetoram 25% WG	45	16.74 (4.21) [a]	6.71 (2.59) [e]	55.47	3.84 (1.96) [e]	72.88	2.90 (1.70) [e]	81.00	3.05 (1.74) [e]	80.25	4.53 (2.12) [e]	72.71
T_5	Fipronil 5.00% SC	100	16.64 (4.19) [a]	9.34 (3.06) [bc]	38.02	7.24 (2.69) [c]	48.87	5.70 (2.38) [c]	62.65	5.83 (2.41) [c]	62.24	7.18 (2.68) [c]	56.75
T_6	Imidacloprid 17.80% SL	25	16.19 (4.15) [a]	10.41 (3.23) [b]	30.92	9.08 (3.01) [b]	35.88	6.90 (2.63) [b]	54.78	7.10 (2.66) [b]	54.02	8.53 (2.92) [b]	48.61
T_7	Untreated control		16.02 (4.13) [a]	15.07 (3.87) [a]		14.16 (3.76) [a]		15.26 (3.90) [a]		15.44 (3.92) [a]		16.60 (4.07) [a]	
S.Em (±)			0.049	0.071		0.128		0.032		0.032		0.046	
CD (P=0.05)			N/A	0.302		0.150		0.225		0.264		0.223	

Figures in parentheses are square root transformed values
NS: Non significant; DBS: Day before spraying: DAS: Days after spraying

Table 2: Effect of Spinetoram 25% WG against thrips (*T. tabaci*) after the second spray in cotton

Sl. No.	Treatment	Dosage (g. ai. /ha)	Second spray										Yield (qt/ha)
			1 DAS	% Reduction over control	3 DAS	% Reduction over control	7 DAS	% Reduction over control	10 DAS	% Reduction over control	14 DAS	% Reduction over control	
T_1	Spinetoram 25% WG	24	5.38 (2.32) [c]	64.49	4.63 (2.14) [c]	65.40	4.25 (2.05) [a]	66.54	3.90 (1.95) [c]	67.77	3.73 (1.91) [cd]	68.26	16.75 (4.09) [c]
T_2	Spinetoram 25% WG	30	4.10 (2.02) [d]	72.94	3.35 (1.82) [d]	74.96	3.05 (1.73) [a]	75.98	2.88 (1.67) [c]	76.20	2.70 (1.63) [d]	77.02	19.00 (4.35) [b]
T_3	Spinetoram 25% WG	36	2.88 (1.69) [e]	80.99	2.28 (1.48) [e]	82.96	1.85 (1.34) [c]	85.43	1.63 (1.24) [d]	86.53	1.45 (1.18) [e]	87.66	21.75 (4.66) [a]
T_4	Spinetoram 25% WG	45	2.78 (1.65) [e]	81.65	2.08 (1.41) [e]	84.45	1.73 (1.34) [c]	86.38	1.50 (1.17) [d]	87.60	1.38 (1.14) [e]	88.26	22.50 (4.74) [a]
T_5	Fipronil 5.00% SC	100	5.40 (2.32) [d]	64.36	4.58 (2.13) [c]	65.77	4.20 (2.03) [d]	66.93	3.85 (1.93) [c]	68.18	3.93 (1.95) [c]	66.55	16.50 (4.06) [c]
T_6	Imidacloprid 17.80% SL	25	6.75 (2.60) [b]	55.45	6.10 (2.47) [b]	54.41	5.68 (2.38) [c]	55.28	5.33 (2.30) [b]	55.95	5.15 (2.27) [b]	56.17	15.00 (3.86) [c]
T_7	Untreated control		15.15 (3.89) [a]		13.38 (3.66) [a]		12.70 (3.56) [b]		12.10 (3.48) [a]		11.75 (3.43) [a]		12.00 (3.46) [d]
S.Em (±)			0.280		0.058		0.084		0.072		0.052		0.081
CD (P=0.05)			0.242		0.284		0.311		0.409		0.414		0.324

Figures in parentheses are square root transformed values
NS: Non significant; DBS: Day before spraying: DAS: Days after spraying

Table 3: Effect of Spinetoram 25% WG on spiders in cotton

Sl. No.	Treatment	Dosage (g. ai. /ha)	First spray						Second spray				
			1 DBS	1 DAS	3 DAS	5 DAS	7 DAS	10 DAS	1 DAS	3 DAS	5 DAS	7 DAS	10 DAS
T_1	Spinetoram 25% WG	24	1.40 (1.18)	1.10 (1.05)^b	1.40 (1.18)^b	1.66 (1.29)	1.76 (1.33)	1.96 (1.40)	1.54 (1.23)^b	1.32 (1.15)^b	1.42 (1.19)^b	1.61 (1.27)	1.70 (1.30)^b
T_2	Spinetoram 25% WG	30	1.44 (1.20)	1.10 (1.05)^b	1.37 (1.17)^b	1.63 (1.28)	1.74 (1.32)	1.94 (1.39)	1.47 (1.20)^b	1.32 (1.15)^b	1.44 (1.20)^b	1.60 (1.27)	1.65 (1.29)^b
T_3	Spinetoram 25% WG	36	1.30 (1.14)	1.04 (1.02)^b	1.27 (1.13)^b	1.59 (1.26)	1.70 (1.30)	1.93 (1.38)	1.40 (1.17)^b	1.30 (1.14)^b	1.41 (1.18)^b	1.56 (1.25)	1.65 (1.28)^b
T_4	Spinetoram 25% WG	45	1.33 (1.15)	0.92 (0.96)^b	1.13 (1.06)^b	1.40 (1.18)	1.67 (1.29)	1.88 (1.37)	1.20 (1.09)^b	1.10 (1.05)^b	1.33 (1.15)^b	1.54 (1.24)	1.65 (1.28)^b
T_5	Fipronil 5.00% SC	100	1.30 (1.14)	1.00 (1)^b	1.32 (1.15)^b	1.61 (1.27)	1.71 (1.30)	1.89 (1.37)	1.43 (1.19)^b	1.24 (1.11)^b	1.47 (1.21)^b	1.55 (1.24)	1.60 (1.27)^b
T_6	Imidacloprid 17.80% SL	25	1.32 (1.15)	1.00 (1)^b	1.34 (1.16)^b	1.63 (1.27)	1.68 (1.29)	1.83 (1.35)	1.40 (1.18)^b	1.25 (1.11)^b	1.43 (1.20)^b	1.54 (1.24)	1.67 (1.29)^b
T_7	Untreated control		1.40 (1.17)	1.54 (1.24)^a	1.86 (1.36)^a	2.03 (1.42)	2.08 (1.44)	2.43 (1.56)	2.33 (1.53)^a	2.30 (1.52)^a	2.40 (1.55)^a	2.30 (1.51)	2.23 (1.49)^a
	S.Em (±)			0.03	0.046				0.060	0.041	.06		0.026
	CD (P=0.05)		NS	0.092	0.138	NS	NS	NS	0.181	0.122	0.187	NS	0.077

Figures in parentheses are square root transformed values
NS: Non significant; DBS: Day before spraying: DAS: Days after spraying

Table 4: Effect of Spinetoram 25% WG on Ladybird beetle in cotton

Sl. No.	Treatment	Dosage (g. ai. /ha)	First spray						Second spray				
			1 DBS	1 DAS	3 DAS	5 DAS	7 DAS	10 DAS	1 DAS	3 DAS	5 DAS	7 DAS	10 DAS
T_1	Spinetoram 25% WG	24	2.50 (1.58)	2.10 (1.45)^a	1.84 (1.35)^b	2.02 (1.41)	2.31 (1.51)	2.49 (1.57)	1.65 (1.27)^b	1.57 (1.23)^b	1.89 (1.36)	2.14 (1.45)	2.80 (1.67)
T_2	Spinetoram 25% WG	30	2.53 (1.59)	2.00 (1.41)^a	1.80 (1.33)^b	2.01 (1.41)	2.28 (1.56)	2.41 (1.54)	1.67 (1.29)^b	1.53 (1.21)^b	1.86 (1.34)	2.13 (1.46)	2.65 (1.63)
T_3	Spinetoram 25% WG	36	2.40 (1.55)	1.90 (1.38)^a	1.82 (1.33)^b	2.07 (1.44)	2.26 (1.49)	2.47 (1.57)	1.66 (1.29)^b	1.51 (1.21)^b	1.80 (1.32)	2.04 (1.42)	2.75 (1.66)
T_4	Spinetoram 25% WG	45	2.55 (1.59)	1.27 (1.12)^b	1.57 (1.24)^b	1.92 (1.38)	2.21 (1.48)	2.43 (1.56)	1.36 (1.16)^b	1.37 (1.15)^b	1.69 (1.29)	2.00 (1.41)	2.65 (1.63)
T_5	Fipronil 5.00% SC	100	2.50 (1.58)	2.03 (1.43)^a	1.86 (1.36)^b	2.04 (1.42)	2.30 (1.51)	2.37 (1.52)	1.52 (1.22)^b	1.50 (1.20)^b	1.93 (1.38)	2.11 (1.44)	2.70 (1.64)
T_6	Imidacloprid 17.80% SL	25	2.43 (1.56)	1.95 (1.40)^a	1.81 (1.32)^b	2.01 (1.41)	2.32 (1.52)	2.40 (1.53)	1.68 (1.27)^b	1.64 (1.26)^b	1.97 (1.40)	2.18 (1.47)	2.75 (1.66)
T_7	Untreated control	--	2.40 (1.54)	2.43 (1.55)^a	2.50 (1.58)^a	2.55 (1.59)	2.43 (1.56)	2.95 (1.71)	3.00 (1.73)^a	2.48 (1.57)^a	2.70 (1.64)	2.75 (1.66)	2.65 (1.63)
	S.Em (±)			0.06	0.05				0.08	0.07			
	CD (P=0.05)		NS	0.18	0.18	NS	NS	NS	0.25	0.22	NS	NS	NS

Figures in parentheses are square root transformed values
NS: Non significant; DBS: Day before spraying: DAS: Days after spraying

Conclusion

From the above results, the study can conclude that Spinetoram 25% WG @ 45 and 36 g a.i./ha were effective in controlling thrips on the cotton crop with higher yield and were on par with each other. No adverse effect on the natural enemies and no phytotoxic effect on the crop was observed with the application of Spinetoram 25% WG. Spinetoram 25% WG @ 45 and 36 g a.i./ha were on par with each other, therefore Spinetoram 25% WG @ 36 g a.i./ha (144 g/ha) could be used for the control of thrips on cotton crop.

References

1. Abbas MA. General agriculture. 2nd ed. Emporium Publ.; Pakistan; c2021. p. 352.
2. Din M, Nadeem MK, Ali M, Waqar MQ, Ali MA, Masood N. Efficacy of some insecticides against cotton thrips (*Thrips tabaci* Lind.) under natural field conditions. J Environ Agric Sci. 2015;5:1-3.
3. Dively GP, Patton T, Barranco L, Kulhanek K. Comparative efficacy of common active ingredients in organic insecticides against difficult to control insect pests. Insects. 2020;11(9):614.
4. Kkadan SK, Sirait BA, Asfa R, de Souza Tavares W, Tarigan M, Duran, et al. Evaluation of a spinetoram-based insecticide against lepidopteran and thrips infesting acacia and eucalyptus in Sumatra, Indonesia. J Entomol Zool Stud. 2020;8(2):1345-51.
5. Kumar AS, Muthukrishnan N, Maruthpandi K. Field evaluation of Spinetoram 12 SC against leaf damage due to *Spodoptera litura* Fabricius on onion. Int J Curr Microbiol Appl Sci. 2017;6(11):2824-2829.
6. Matharu KS, Tanwar PS. Bioefficacy of novel insecticides against cotton thrips, *Thrips tabaci* (Thysanoptera: Thripidae). Int J Chem Stud. 2020;8(3):1167-1170.
7. Ramalakshmi LD, Padhy D, Rao GP. Bio efficacy of different novel insecticides against cotton thrips, *T. tabaci* in transgenic cotton. Int J Curr Microbiol App Sci. 2020;9(5):88-95.
8. Sahito HA, Shah ZH, Kousar T, Mangrio WM, Mallah NA, Jatoi FA, et al. Comparative efficacy of novel pesticides against jassid, *Amrasca biguttula biguttula*

(Ishida) on cotton crop under field conditions at Khairpur, Sindh, Pakistan. Singap J Sci Res. 2017;1-8.
9. Uthamasamy S. Intra and inter plant behavioural dynamics of the cotton bollworm complex. In: Functional Dynamics of Phytophagous Insects. Ananthakrishnan TN, editor. New Delhi: Oxford and IBH Publishers; c1994. p. 115-131.