

# Comparative Evaluation of Spidoxamat 9.6 % + Spinetoram 12 % WG for Managing Whiteflies and Thrips in Cotton with Minimal Impact on Natural Enemies

Harjindra Singh<sup>1</sup>, Pradeep Kumar<sup>2</sup>, N. K. Sharma<sup>3</sup>, Pawan Kumar<sup>4</sup>

<sup>1</sup>Assistant Professor, Agricultural Research Station, Sri-Ganganagar 335041 (Rajasthan), India  
Corresponding Author Email: [jindra.ento1\[at\]gmail.com](mailto:jindra.ento1[at]gmail.com)

<sup>2,3</sup>ZDR, Professor & PI Cotton, Agricultural Research Station, Sri-Ganganagar 335041 (Rajasthan), India

<sup>4</sup>YP-II in Cotton, Agricultural Research Station, Sri-Ganganagar 335041 (Rajasthan), India

**Abstract:** This study evaluates the efficacy of Spidoxamat 9.6% and Spinetoram 12% WG, applied in varying doses, for managing whiteflies and thrips in cotton crops while assessing their safety toward beneficial natural enemies. Field trials conducted over two kharif seasons (2023 and 2024) at the Agricultural Research Station in Sri-ganganagar involved three replications and eight treatments. Results indicated that its dose of Spidoxamat 9.6 % + Spinetoram 12 % WG @ 375 g/ha achieved the highest reduction in pest populations while maintaining the presence of spiders and other beneficial organisms. The treatment was also found non-phytotoxic and led to increased seed cotton yields, suggesting its suitability as a safer, more effective pest control strategy in cotton cultivation.

**Keywords:** cotton pest management, whiteflies, thrips, Spidoxamat, Spinetoram

## 1. Introduction

Cotton is a major cash crop in India and account 63 per cent of the fiber used in textile industry. Cotton impact the lives of an estimated 60 million people in India, including farmers and workers involved in the cotton industry from processing to trading. India has largest acreage (114.47 lakh ha) under cotton at global level and has the productivity of 436.99 kg Lint/ha and rank first in production (302.25 lakh bales). In Rajasthan, cotton cultivated on 6.27 lakh hectare area, production was 18.45 lakh bales or 313650 tones with average productivity 500.24 kg lint/ha (Cotton Association of India, 2024). It is much valued crop and is grown extensively in the irrigated north-western plain zone comprising Sri-ganganagar and Hanumangarh districts (Zone 1b). The states of Punjab and Haryana forms North-eastern boundary, Churu and Bikaner districts of Rajasthan forms South boundary and International border of Pakistan forms North-western boundary of the zone. The region has contributed sizably towards cotton development in the state. Cotton cultivation started in this part of Rajasthan with the inception of Gang canal in 1929. Insect pests causes significant yield losses in cotton, out of which sucking insect pests like whitefly (*Bemisia tabaci*, *Amrasca biguttula*, *Thrips tabaci*) jassids and lint stainer (*Dysdercus koenigii*, *Oxycarenus laetus*) and bollworms (*Earias insulana*, *Pectinophora gossypiella*, *Helicoverpa armigera*), foliage feeders (*Spodoptera litura*, *Sylepta derogata*), are of major importance in the zone. Among sucking insect pests, whiteflies and thrips are among the most damaging, it's caused damage to cotton at vegetative stage and its II nd flush before 15 September and affect both quality and quantity. Agarwal and katiyar 1979, reported 20.21 per cent losses in seed cotton, similarly Dhawan *et al.* 1987, noticed up to 50.47 and 36.63 per cent yield losses due to pink

bollworm in *Gossypium hirsutum* and *G. arborium* in Punjab. However, in Gujarat and southern part (Telangana and Andhra Pradesh) of India pink bollworm infestation was noticed in increasing trend on non-Bt and Bt cotton in last decade. This study aims to identify the most effective and ecologically safe dose of Spidoxamat 9.6% + Spinetoram 12% WG for managing whiteflies and thrips in cotton cultivation. (Spidoxamat has molecular formula is C<sub>19</sub>H<sub>22</sub>ClNO<sub>4</sub> and molecular weight is 363.8 g/mol. It is an insecticide it belongs to the chemical class of tetramic acid derivatives, functioning as an inhibitor of acetyl-CoA carboxylase (ACCase). This unique mode of action disrupts the lipid biosynthesis pathway in target insects, leading to their eventual mortality while Spinetoram (Spinosyn L and Spinosyn G) is one of a green bio-insecticides belongs to the "Spinosyns" (IRAC Group 5) group and produced during the fermentation process of the soil actinomycete *Saccharopolyspora spinosa* (Sparks *et al.*, 2020) and has water dispersible granules Its mode of action is a unique neurotoxic effect that primarily involves disrupting the insect's nervous system through both contact and ingestion) Therefore, the testing of the combination of suitable doses of Spinetoram 12% WG with new product, spidoxamat 9.6 % against thrips and whitefly pests on cotton crop had been undertaken. This research is significant in developing sustainable pest control strategies that balance high efficacy with minimal ecological disruption, contributing to safer cotton production practices.

## 2. Methodology

This trial evaluated optimal insecticide doses for managing whiteflies and thrips and safer for their natural enemies out of the doses of Spidoxamat 9.6 % + Spinetoram 12 % WG in cotton crop with three replication and eight treatments at

Agricultural Research Station, Sri-ganganagar during *kharif* 2023 & 2024 and seed provided by the M/s Bayer Crop Science Pvt. Ltd, RCH 776 BG-II variety under randomized block design within three replication with recommended package of practice and three applications of prescribed treatments were given when the pest' population reached at economic threshold level. Populations were recorded on six leaves per plant (two each from the top, middle, and lower canopy) per plant from five randomly selected and tagged plants in each plot. Pre-treatment counts and post-treatment counts were recorded 3, 7 and 10 days after each application. Although insecticides were applied three times, however the population of thrips was not considerable after the third spray. Therefore, only two sprays were considered in analysis viz- thrips population after the first and second spray while whitefly population observations were consider in analysis & per cent increase/reduction in all these parameters in different treatments over control was also calculated. The safety of tested insecticides to the predators was assessed by recording the population of natural enemies on five randomly selected and tagged plants before spray and 5 and 10 days after each spray. Among natural enemies, spiders were found in considerable number. Some data was calculated as percentage using of Henderson and Tilton's formula for efficacy calculation is appropriate it to be a modification of Abbot' s (1925) formula:

$$\text{Percentage reduction} = \frac{100 \times (1 - \frac{\text{Ta} \times \text{Cb}}{\text{Ta} \times \text{Cb}})}{(\text{Ta} \times \text{Cb})}$$

Where, Ta – Number of insects after treatment of spray

T b - Number of insects before treatment of spray

Ca - Number of insects in untreated control after treatment of spray

C b - Number of insects in untreated control before treatment of spray

Some data were subjected to ANOVA after transformed them to  $\sqrt{X} + 0.5$  using formulae. Finally the seed cotton yield was recorded in kg per plot in each treatment and then converted in to q/ha. Per cent increase in yield in different treatments over control was also calculated.

### 3. Results

The result revealed that the Spidoxamat 9.6% + Spinetoram 12% WG at 36 + 45 g a.i./ha effectively reduced thrips and whitefly populations on cotton in comparison to overall tested chemicals. On thrips after the first spray, the treatment resulted in significantly lower mean population of thrips (6.57 thrips/leaf). Similarly, after the second spray, this treatment remained the most effective on the thrips population to 4.38 thrips/leaf during *kharif* 2023. The mean thrips population (5.47 thrips/leaf) remained consistently low across multiple treatments both sprays. The reduction of the thrips with spidoxamat 9.6 % + spinetoram 12% WG at 36 + 45 g a.i. per ha consistently achieved the highest reduction in thrips population that was 67.71 % (Table 1.A & 1.C). During *kharif* 2024, the population of sucking pests

was low due to frequent irrigation. After the first spray, among all, the treatment involving spidoxamat 9.6% + spinetoram 12% WG @ 36 + 45 g a.i. per ha resulted in significantly lower mean population of thrips (4.46 thrips/leaf). Similarly, after the second spray, this treatment remained the most effective on the thrips population to 2.88 thrips/leaf. The mean thrips population (3.67 thrips/leaf) remained consistently low across multiple treatments both sprays respectively. Overall percentage reduction of the thrips with spidoxamat 9.6% + spinetoram 12% WG at 36 + 45 g a.i. per ha consistently achieved the highest reduction in thrips population that was 75.53 % (Table 2.A & 2.D). Similarly results of *kharif* 2023 season on whitefly population revealed that after the first spray, the plots treated with spidoxamat 9.6% + spinetoram 12% @ 36 + 45 g a.i. per ha resulted significantly lower mean population of whitefly (2.14 adults/leaf) across multiple treatments while the lower dose (30 + 37.5 g a.i./ha) of the same chemical (3.02 whitefly/leaf) and spinetoram 11.70% SC (3.09 whitefly/leaf) significantly found equally effective. Mean percent reduction of the whitefly with spidoxamat 9.6% + spinetoram 12% WG at 36 + 45 g a.i. per ha consistently achieved the highest (75.28 per cent) reduction in thrips population (Table 3.A & 3.D) and along with this after the second spray increase the population of whitefly, the spidoxamat 9.6% + spinetoram 12% @ 36 + 45 g a.i. per ha resulted in lowest (4.27 adults/leaf) mean population of whitefly across the other treatments. Then both chemicals spinetoram 11.70% SC (5.59 whitefly/leaf) and the lower dose (30 + 37.5 g a.i./ha) of the testing chemical 6.04 whitefly/leave revealed equally effective. Mean per cent reduction of the whitefly with spidoxamat 9.6% + spinetoram 12% WG at 36 + 45 g a.i. per ha consistently achieved the highest reduction in thrips population (75.06 per cent) (Table 3.B & 3.D). Similarly after the third spray increase the population of whitefly, the plots treated with spidoxamat 9.6% + spinetoram 12% @ 36 + 45 g a.i. per ha resulted in lowest mean population of whitefly (4.27 adults/leaf) than the other treatments. Overall also lowest population of whitefly (2.61 whitefly /leaf) and reduction was highest 77.61 per cent. Similarly results revealed during 2024 after first spray the mean population of whitefly with the effective was significantly lower (0.84 whitefly /leaf) than that in rest of others while increased after second spray observed 3.15 and in third application again decreases by 1.27 adults/leaf and then in other treatments as can see in the table 4.A, B, C. and the mean reduction was highest in the effective dose of the treatment observed 75.28, 75.06 and 82.51 percent respectively than in other treatment as shown in the table 4.D.

**Effect of insecticides on natural enemies:** The data are presented by combining three sprays of each year *kharif* 2023 and 2024 as shown in the table5 overall mean population of NEs in treatment involving Spidoxamat 9.6% + Spinetoram 12% WG at 36 + 45 g a.i./ha was lower on spiders/5 plants but higher in other tested chemicals as shown in the table number 5.

**Table 1: (A) Evaluation of different treatments against thrips of cotton during *Kharif*-2023 (first Spray)**

S. No.	Treatment	a.i./ha	Dose ml or g/ha	No. of thrips population after 1 <sup>st</sup> spray (DAS)									
				Thrips/ leaves (DAS)									
				PS		3 DAS		7 DAS		10 DAS		MEAN	
				OV	TV	OV	TV	OV	TV	OV	TV	OV	TV
1	Untreated control		-	21.08	4.65	19.52	4.47	21.37	4.68	26.91	5.24	22.60	4.81
2	Spidoxamat 9.6% + Spinetoram 12% WG	24+30	250 g	17.99	4.30	7.80	2.88	9.47	3.16	12.60	3.62	9.96	3.23
3	Spidoxamat 9.6% + Spinetoram 12% WG	30+37.5	312.5 g	18.13	4.29	5.42	2.43	8.22	2.95	12.66	3.63	8.77	3.04
4	Spidoxamat 9.6% + Spinetoram 12% W	36+45	375 g	19.47	4.47	4.57	2.22	6.21	2.56	8.93	3.07	6.57	2.65
5	Spidoxamat 4.8%	36	750 g	17.30	4.22	7.46	2.82	8.94	3.07	12.79	3.61	9.73	3.19
6	Spinetoram 11.70 % SC	45	375 ml	18.14	4.32	6.30	2.61	8.60	3.02	9.59	3.18	8.16	2.94
7	Chlorpyrifos50% Cypermrthrin5% EC	500 +50	1000 ml	18.22	4.33	6.92	2.72	9.63	3.18	13.73	3.77	10.09	3.25
	S.Em ±				0.16		0.13		0.14		0.17		0.09
	CD at 5%				0.49		0.38		0.42		0.52		0.28
	CV %				5.71		5.53		5.36		5.79		3.50

DAS: Days after Spray, \* Values in TV indicates Square root + 0.5 values &amp; OV indicates actual values

**Table 1: (B) Evaluation of different treatments against thrips of cotton during *Kharif*-2023 (Second Spray)**

S. No.	Treatment	a.i./ha	Dose ml or g/ha	No. of thrips population after 1 <sup>st</sup> spray (DAS)									
				Thrips/ leaves (DAS)									
				Pre Spray		3 DAS		7 DAS		10 DAS		MEAN	
				OV	TV	OV	TV	OV	TV	OV	TV	OV	TV
1	Untreated control	-	-	27.41	5.28	29.78	5.50	7.21	2.78	9.98	3.24	12.32	3.58
2	Spidoxamat 9.6% + Spinetoram 12% WG	24+30	250 g	27.96	5.33	13.56	3.75	3.42	1.96	5.47	2.44	7.48	2.82
3	Spidoxamat 9.6% + Spinetoram 12% WG	30+37.5	312.5 g	26.35	5.13	7.70	2.86	2.53	1.74	4.39	2.19	4.87	2.32
4	Spidoxamat 9.6% + Spinetoram 12% W	36+45	375 g	29.44	5.47	7.38	2.77	1.95	1.57	3.80	2.07	4.38	2.20
5	Spidoxamat 4.8%	36	750 g	27.27	5.27	11.55	3.47	3.15	1.91	6.02	2.55	6.91	2.72
6	Spinetoram 11.70 % SC	45	375 ml	28.11	5.35	8.14	2.94	2.96	1.86	5.20	2.39	5.43	2.44
7	Chlorpyrifos50% Cypermrthrin5% EC	500 +50	1000 ml	28.19	5.36	11.89	3.52	2.91	1.85	6.42	2.63	7.07	2.75
	S.Em ±				0.25		0.17		0.09		0.11		0.07
	CD at 5%				0.74		0.51		0.27		0.35		0.22
	CV %				5.78		6.18		5.70		5.82		5.46

DAS: Days after Spray, \* Values in TV indicates Square root + 0.5 values &amp; OV indicates actual values

**Table 1: © Per cent reduction in thrips population in different treatments over control in cotton during *kharif* 2023**

Treatments	Dose (g a.i./ha)	Per cent reduction in thrips population over control								Overall Mean
		1 <sup>st</sup> spray				2 <sup>nd</sup> spray				
		3 DAS	7 DAS	10 DAS	Mean	3 DAS	7 DAS	10 DAS	Mean	
Untreated Control	--	--	--	--	--	--	--	--	--	
Spidoxamat 9.6 % + Spinetoram 12 % WG	24 + 30	60.04	55.68	53.18	<b>55.94</b>	31.45	52.58	45.18	<b>39.27</b>	<b>47.61</b>
Spidoxamat 9.6 % + Spinetoram 12 % WG	30 + 37.5	72.23	61.53	52.95	<b>61.21</b>	61.07	64.90	56.02	<b>60.45</b>	<b>60.83</b>
Spidoxamat 9.6 % + Spinetoram 12 % WG	36 + 45	76.59	70.96	66.81	<b>70.93</b>	62.69	72.94	61.92	<b>64.48</b>	<b>67.71</b>
Spidoxamat 4.8 % WG	36	61.78	58.19	52.47	<b>56.95</b>	41.61	56.29	39.67	<b>43.95</b>	<b>50.45</b>
Spinetoram 11.70 % SC	45	67.73	59.76	64.36	<b>63.88</b>	58.85	58.93	47.90	<b>55.91</b>	<b>59.89</b>
Chlorpyrifos 50 % + Cypermethrin 5 % EC	500 + 50	64.55	54.95	48.98	<b>55.34</b>	39.89	59.62	35.65	<b>42.59</b>	<b>48.97</b>

DAS= Days after spray

**Table 2 (A): Evaluation of different treatments against thrips of cotton during *Kharif*-2024 (first Spray)**

S. No.	Treatment	a.i./ha	Dose ml or g/ha	No. of thrips population after 1 <sup>st</sup> spray (DAS)									
				Thrips/ leaves (DAS)									
				PS		3 DAS		7 DAS		10 DAS		MEAN	
				OV	TV	OV	TV	OV	TV	OV	TV	OV	TV
1	Untreated control		-	10.37	3.30	14.79	3.91	18.32	4.34	24.65	5.01	19.25	4.44
2	Spidoxamat 9.6% + Spinetoram 12% WG	24+30	250 g	10.31	3.29	6.46	2.64	7.21	2.78	10.37	3.30	8.01	2.92
3	Spidoxamat 9.6% + Spinetoram 12% WG	30+37.5	312.5 g	10.19	3.27	3.95	2.11	5.96	2.52	8.19	2.93	6.03	2.54
4	Spidoxamat 9.6% + Spinetoram 12% W	36+45	375 g	10.37	3.27	3.23	1.89	4.37	2.21	5.77	2.50	4.46	2.22
5	Spidoxamat 4.8%	36	750 g	13.84	3.79	6.92	2.72	7.54	2.84	10.50	3.32	8.32	2.97
6	Spinetoram 11.70 % SC	45	375 ml	10.45	3.31	4.21	2.17	7.14	2.76	8.11	2.93	6.49	2.64
7	Chlorpyrifos50% Cypermrthrin5% EC	500 +50	1000 ml	10.09	3.25	7.69	2.86	8.36	2.98	13.36	3.72	9.80	3.21
	S.Em ±				<b>0.15</b>		<b>0.13</b>		<b>0.12</b>		<b>0.13</b>		<b>0.09</b>
	CD at 5%				<b>0.46</b>		<b>0.40</b>		<b>0.36</b>		<b>0.41</b>		<b>0.27</b>
	CV %				<b>5.69</b>		<b>6.39</b>		<b>5.21</b>		<b>5.05</b>		<b>5.72</b>

DAS: Days after Spray, \* Values in TV indicates Square root + 0.5 values &amp; OV indicates actual values

**Table 2 (B):** Evaluation of different treatments against thrips of cotton during *Kharif-2024* (Second Spray)

S. No.	Treatment	a.i./ha	Dose ml or g/ha	No. of thrips population after II <sup>nd</sup> spray (DAS)									
				Thrips/leaves (DAS)									
				Pre Spray		3 DAS		7 DAS		10 DAS		MEAN	
				OV	TV	OV	TV	OV	TV	OV	TV	OV	TV
1	Untreated control	-	-	10.37	3.30	14.95	3.93	9.61	3.18	8.89	3.06	11.15	3.41
2	Spidoxamat 9.6% + Spinetoram 12% WG	24+30	250 g	10.07	3.24	7.15	2.77	2.81	1.81	3.59	2.00	4.52	2.24
3	Spidoxamat 9.6% + Spinetoram 12% WG	30+37.5	312.5 g	10.14	3.26	5.10	2.37	1.91	1.54	2.79	1.81	3.27	1.94
4	Spidoxamat 9.6% + Spinetoram 12% W	36+45	375 g	10.50	3.32	4.80	2.25	1.47	1.41	2.35	1.69	2.88	1.83
5	Spidoxamat 4.8%	36	750 g	10.54	3.31	7.98	2.91	2.35	1.69	4.42	2.22	4.92	2.33
6	Spinetoram 11.70 % SC	45	375 ml	13.36	3.72	5.81	2.51	2.21	1.65	3.96	2.11	3.99	2.12
7	Chlorpyrifos50% Cypermrthrin5% EC	500 +50	1000 ml	11.13	3.41	8.53	3.00	2.30	1.67	4.83	2.31	5.22	2.39
S.Em ±					0.16		0.17		0.08		0.10		0.07
CD at 5%					0.48		0.51		0.26		0.30		0.21
CV %					5.90		7.50		5.93		5.74		5.89

DAS: Days after Spray, \* Values in TV indicates Square root + 0.5 values &amp; OV indicates actual values

**Table 2 (C):** Per cent reduction in thrips population in different treatments over control in cotton during *kharif* 2024

Treatments	Dose (g a.i./ha)	Per cent reduction in thrips population over control								Overall Mean
		1 <sup>st</sup> spray				2 <sup>nd</sup> spray				
		3 DAS	7 DAS	10 DAS	Mean	3 DAS	7 DAS	10	Mean	
Untreated Control	--	--	--	--	--	--	--	--	--	
Spidoxamat 9.6 % + Spinetoram 12 % WG	24 + 30	56.35	60.65	57.90	<b>58.38</b>	52.17	70.74	59.65	<b>59.49</b>	<b>58.94</b>
Spidoxamat 9.6 % + Spinetoram 12 % WG	30 + 37.5	73.29	67.47	66.76	<b>68.66</b>	65.89	80.11	68.59	<b>70.69</b>	<b>69.67</b>
Spidoxamat 9.6 % + Spinetoram 12 % WG	36 + 45	78.15	76.16	76.59	<b>76.85</b>	67.88	84.66	73.53	<b>74.20</b>	<b>75.53</b>
Spidoxamat 4.8 % WG	36	53.24	58.84	57.39	<b>56.79</b>	46.62	75.52	50.23	<b>55.88</b>	<b>56.34</b>
Spinetoram 11.70 % SC	45	71.53	61.03	67.09	<b>66.31</b>	61.14	77.00	55.43	<b>64.18</b>	<b>65.24</b>
Chlorpyrifos 50 % + Cypermethrin 5 % EC	500 + 50	48.01	54.37	45.79	<b>49.08</b>	42.94	76.08	45.73	<b>53.20</b>	<b>51.14</b>

DAS= Days after spray

**Table 3 (A):** Evaluation of different treatments against whitefly of cotton during *Kharif- 2023* (first Spray)

S. No.	Treatment	a.i./ha	Dose ml or g/ha	No. of whitefly population after 1 <sup>st</sup> spray (DAS)									
				Thrips/3 leaves (DAS)									
				PS		3 DAS		7 DAS		10 DAS		MEAN	
				OV	TV	OV	TV	OV	TV	OV	TV	OV	TV
1	Untreated control		-	10.49	3.31	9.89	3.22	9.20	3.11	6.93	2.73	8.67	3.03
2	Spidoxamat 9.6% + Spinetoram 12% WG	24+30	250 g	10.61	3.33	3.73	2.06	3.46	1.99	3.34	1.95	3.51	2.00
3	Spidoxamat 9.6% + Spinetoram 12% WG	30+37.5	312.5 g	10.29	3.26	2.84	1.81	2.96	1.86	3.25	1.94	3.02	1.86
4	Spidoxamat 9.6% + Spinetoram 12% W	36+45	375 g	10.36	3.30	2.02	1.59	2.05	1.60	2.36	1.69	2.14	1.63
5	Spidoxamat 4.8%	36	750 g	10.51	3.32	3.11	1.90	3.12	1.89	3.38	1.97	3.20	1.92
6	Spinetoram 11.70 % SC	45	375 ml	10.56	3.33	3.00	1.87	2.98	1.87	3.29	1.95	3.09	1.89
7	Chlorpyrifos50% Cypermrthrin5% EC	500 +50	1000 ml	10.50	3.32	2.99	1.87	3.81	2.08	3.71	2.05	3.50	2.00
S.Em ±					0.15		0.08		0.08		0.08		0.09
CD at 5%					0.46		0.25		0.26		0.25		0.27
CV %					5.79		5.20		5.31		5.10		5.44

DAS: Days after Spray, \* Values in TV indicates Square root + 0.5 values &amp; OV indicates actual values

**Table 3 (B):** Evaluation of different treatments against whitefly of cotton during *Kharif-2023* (second spray)

S. No.	Treatment	a.i./ha	Dose ml or g/ha	No. of whitefly population after II <sup>rd</sup> spray (DAS)									
				Whitefly/ leaves (DAS)									
				Pre Spray		3 DAS		7 DAS		10 DAS		MEAN	
				OV	TV	OV	TV	OV	TV	OV	TV	OV	TV
1	Untreated control	-	-	20.51	4.58	21.02	4.64	15.92	4.05	14.47	3.87	17.14	4.20
2	Spidoxamat 9.6% + Spinetoram 12% WG	24+30	250 g	19.47	4.47	7.47	2.82	6.92	2.72	6.69	2.66	7.03	2.74
3	Spidoxamat 9.6% + Spinetoram 12% WG	30+37.5	312.5 g	19.38	4.40	5.68	2.46	5.93	2.50	6.50	2.65	6.04	2.55
4	Spidoxamat 9.6% + Spinetoram 12% W	36+45	375 g	18.49	4.36	4.11	2.15	4.28	2.19	4.43	2.22	4.27	2.18
5	Spidoxamat 4.8%	36	750 g	19.51	4.47	7.83	2.89	6.55	2.65	6.58	2.66	6.99	2.74
6	Spinetoram 11.70 % SC	45	375 ml	19.42	4.46	5.21	2.39	6.52	2.65	5.05	2.36	5.59	2.46
7	Chlorpyrifos50% Cypermrthrin5% EC	500 +50	1000 ml	19.84	4.51	5.78	2.51	7.62	2.85	7.43	2.82	6.94	2.73
S.Em ±					0.26		0.11		0.15		0.12		0.08
CD at 5%					0.77		0.35		0.45		0.38		0.26
CV %					7.19		5.13		6.73		5.77		4.91

DAS: Days after Spray, \* Values in TV indicates Square root + 0.5 values &amp; OV indicates actual values



**Table 3 (C):** Evaluation of different treatments against whitefly of cotton during *Kharif*-2023 (third spray)

S. No.	Treatment	a.i./ha	Dose ml or g/ha	No. of whitefly population after IIIrd spray (DAS)									
				Whitefly/ leaves (DAS)									
				Pre Spray		3 DAS		7 DAS		10 DAS		MEAN	
				OV	TV	OV	TV	OV	TV	OV	TV	OV	TV
1	Untreated control	-	-	14.37	3.86	11.02	3.39	7.91	2.90	5.47	2.44	8.13	2.94
2	Spidoxamat 9.6% + Spinetoram 12% WG	24+30	250 g	14.60	3.89	2.49	1.72	2.31	1.66	2.43	1.70	2.41	1.69
3	Spidoxamat 9.6% + Spinetoram 12% WG	30+37.5	312.5 g	14.41	3.80	1.89	1.54	1.98	1.57	2.17	1.63	2.01	1.58
4	Spidoxamat 9.6% + Spinetoram 12% W	36+45	375 g	12.34	3.58	1.31	1.35	1.43	1.39	1.53	1.42	1.42	1.39
5	Spidoxamat 4.8%	36	750 g	14.49	3.87	2.04	1.59	2.36	1.69	3.19	1.92	2.53	1.74
6	Spinetoram 11.70 % SC	45	375 ml	12.96	3.67	1.64	1.46	2.13	1.62	2.40	1.70	2.06	1.60
7	Chlorpyrifos50% Cypermrthrin5% EC	500 +50	1000 ml	15.34	3.98	2.20	1.64	2.54	1.74	2.88	1.84	2.54	1.74
S.Em ±				0.23		0.07		0.07		0.06		0.07	
CD at 5%				0.70		0.22		0.22		0.18		0.22	
CV %				7.60		5.07		5.21		5.17		5.02	

DAS: Days after Spray, \* Values in TV indicates Square root + 0.5 values &amp; OV indicates actual values

**Table 3 (D):** Per cent reduction in whitefly population in different treatments over control in cotton during *kharif* 2023

Treatments	Dose (g a.i./ha)	Per cent reduction in whitefly population over control												Overall Mean
		Ist spray (DAS)				II nd spray (DAS)				III rd Spray (DAS)				
		3	7	10	M	3	7	10	M	3	7	10	M	
Untreated Control	--	--	--	--	M	--	--	--	M	-	-	-	M	--
Spidoxamat 9.6 % + Spinetoram 12 % WG	24 + 30	62.24	62.39	51.77	<b>59.50</b>	64.46	56.53	53.77	<b>58.99</b>	77.40	70.83	55.55	<b>70.37</b>	<b>62.96</b>
Spidoxamat 9.6 % + Spinetoram 12 % WG	30 + 37.5	71.29	67.78	53.11	<b>65.22</b>	72.98	62.75	55.09	<b>64.78</b>	82.84	75.03	60.37	<b>75.27</b>	<b>68.42</b>
Spidoxamat 9.6 % + Spinetoram 12 % WG	36 + 45	79.58	77.72	65.90	<b>75.28</b>	80.44	73.09	69.41	<b>75.06</b>	88.11	81.96	72.01	<b>82.51</b>	<b>77.61</b>
Spidoxamat 4.8 % WG	36	68.55	66.07	51.23	<b>63.06</b>	62.74	58.88	54.50	<b>59.23</b>	81.48	70.18	41.64	<b>68.89</b>	<b>63.73</b>
Spinetoram 11.70 % SC	45	69.67	67.61	52.53	<b>64.37</b>	75.21	59.05	65.10	<b>67.37</b>	85.11	73.09	56.09	<b>74.71</b>	<b>68.82</b>
Chlorpyrifos 50 % + Cypermethrin 5 % EC	500 + 50	69.77	58.60	46.41	<b>59.60</b>	72.50	52.15	48.67	<b>59.49</b>	80.03	67.92	47.39	<b>68.79</b>	<b>62.63</b>

DAS= Days after spray, M- Mean

**Table 4 (A):** Evaluation of different treatments against whitefly of cotton during *Kharif*-2024 (first spray)

S. No.	Treatment	a.i./ha	Dose ml or g/ha	No. of whitefly population after Ist spray (DAS)									
				whitefly/ leaves (DAS)									
				PS		3 DAS		7 DAS		10 DAS		MEAN	
				OV	TV	OV	TV	OV	TV	OV	TV	OV	TV
1	Untreated control	-	-	7.32	2.79	5.84	2.52	3.17	1.92	5.95	2.54	4.99	2.34
2	Spidoxamat 9.6% + Spinetoram 12% WG	24+30	250 g	7.71	2.87	2.97	1.85	1.68	1.46	1.56	1.41	2.07	1.58
3	Spidoxamat 9.6% + Spinetoram 12% WG	30+37.5	312.5 g	7.39	2.79	1.99	1.58	1.18	1.30	1.46	1.40	1.54	1.43
4	Spidoxamat 9.6% + Spinetoram 12% W	36+45	375 g	6.97	2.73	1.29	1.34	0.66	1.08	0.58	1.04	0.84	1.16
5	Spidoxamat 4.8%	36	750 g	7.62	2.85	2.95	1.86	1.34	1.36	1.74	1.50	2.01	1.58
6	Spinetoram 11.70 % SC	45	375 ml	7.67	2.86	2.03	1.59	1.17	1.29	1.26	1.33	1.49	1.41
7	Chlorpyrifos50% Cypermrthrin5% EC	500 +50	1000 ml	7.60	2.85	2.05	1.60	2.02	1.59	1.93	1.56	2.00	1.58
S.Em ±				0.14		0.08		0.06		0.09		0.09	
CD at 5%				0.42		0.24		0.20		0.27		0.27	
CV %				6.15		5.71		5.97		7.24		7.03	

DAS: Days after Spray, \* Values in TV indicates Square root + 0.5 values &amp; OV indicates actual values

**Table 4 (B):** Evaluation of different treatments against whitefly of cotton during *Kharif*-2024 (second spray)

S. No.	Treatment	a.i./ha	Dose ml or g/ha	No. of whitefly population after II nd spray (DAS)									
				whitefly/ leaves (DAS)									
				Pre Spray		3 DAS		7 DAS		10 DAS		MEAN	
				OV	TV	OV	TV	OV	TV	OV	TV	OV	TV
1	Untreated control	-	-	11.76	3.50	11.87	3.52	8.76	3.04	7.33	2.80	9.32	3.13
2	Spidoxamat 9.6% + Spinetoram 12% WG	24+30	250 g	11.34	3.44	5.66	2.47	5.61	2.45	4.30	2.18	5.19	2.38
3	Spidoxamat 9.6% + Spinetoram 12% WG	30+37.5	312.5 g	11.49	3.42	4.00	2.12	4.62	2.26	4.21	2.17	4.25	2.17
4	Spidoxamat 9.6% + Spinetoram 12% W	36+45	375 g	10.36	3.30	3.14	1.91	2.97	1.86	3.34	1.95	3.15	1.91
5	Spidoxamat 4.8%	36	750 g	11.52	3.47	5.26	2.39	4.94	2.33	4.80	2.30	5.00	2.34
6	Spinetoram 11.70 % SC	45	375 ml	11.04	3.40	4.66	2.27	3.43	1.98	4.76	2.29	4.40	2.21
7	Chlorpyrifos50% Cypermrthrin5% EC	500 +50	1000 ml	11.71	3.49	5.37	2.42	6.31	2.61	6.12	2.57	5.93	2.54
S.Em ±				0.20		0.10		0.10		0.09		0.08	
CD at 5%				0.60		0.31		0.30		0.28		0.25	
CV %				7.26		5.32		5.36		5.10		4.37	

DAS: Days after Spray, \* Values in TV indicates Square root + 0.5 values &amp; OV indicates actual values

**Table 4 (C):** Evaluation of different treatments against whitefly of cotton during *Kharif*-2024 (third spray)

S. No.	Treatment	a.i./ha	Dose ml or g/ha	No. of whitefly population after III rd spray (DAS)									
				whitefly/ leaves (DAS)									
				Pre Spray		3 DAS		7 DAS		10 DAS		MEAN	
				OV	TV	OV	TV	OV	TV	OV	TV	OV	TV
1	Untreated control	-	-	12.42	3.59	11.12	3.41	9.01	3.08	7.15	2.77	9.09	3.10
2	Spidoxamat 9.6% + Spinetoram 12% WG	24+30	250 g	10.61	3.33	2.36	1.67	2.18	1.62	2.10	1.60	2.21	1.63
3	Spidoxamat 9.6% + Spinetoram 12% WG	30+37.5	312.5 g	10.52	3.32	1.76	1.50	1.85	1.53	2.04	1.59	1.88	1.54
4	Spidoxamat 9.6% + Spinetoram 12% W	36+45	375 g	9.65	3.19	1.26	1.32	1.30	1.34	1.25	1.32	1.27	1.33
5	Spidoxamat 4.8%	36	750 g	11.11	3.37	2.73	1.80	2.11	1.62	2.06	1.60	2.30	1.67
6	Spinetoram 11.70 % SC	45	375 ml	11.07	3.40	2.49	1.73	2.23	1.65	1.77	1.51	2.16	1.63
7	Chlorpyrifos50% Cypermrthrin5% EC	500 +50	1000 ml	10.63	3.34	2.76	1.81	2.41	1.71	2.35	1.69	2.51	1.73
S.Em ±					0.19		0.09		0.07		0.08		0.07
CD at 5%					0.56		0.27		0.23		0.24		0.23
CV %					6.92		6.06		5.36		5.68		5.31

DAS: Days after Spray, \* Values in TV indicates Square root + 0.5 values & OV indicates actual values

**Table 4 (D):** Per cent reduction in whitefly population in different treatments over control in cotton during *kharif* 2024

Treatments	Dose (g a.i./ha)	Per cent reduction in whitefly population over control												
		Ist spray (DAS)				II nd spray (DAS)				III rd Spray (DAS)				Overall Mean
		3	7	10	M	3	7	10	M	3	7	10	M	
Untreated Control	--	--	--	--	--	--	--	--	--	-	-	-	-	--
Spidoxamat 9.6 % + Spinetoram 12 % WG	24 + 30	49.06	47.08	73.78	58.48	52.30	35.98	41.37	44.32	78.78	76	70.63	75.67	59.49
Spidoxamat 9.6 % + Spinetoram 12 % WG	30 +37.5	65.92	62.79	75.38	69.02	66.29	47.29	42.56	54.40	84.15	80	71.52	79.31	78.44
Spidoxamat 9.6 % + Spinetoram 12 % WG	36 + 45	77.85	79.18	90.28	83.08	73.54	66.07	54.39	66.18	88.71	86	82.52	86.06	60.26
Spidoxamat 4.8 % WG	36	49.49	57.80	70.75	59.70	55.67	43.68	34.52	46.37	75.48	77	71.13	74.70	66.40
Spinetoram 11.70 % SC	45	65.33	63.09	78.82	70.22	60.73	60.86	35.06	52.79	77.61	75	75.24	76.20	56.22
Chlorpyrifos 50 % + Cypermethrin 5 % EC	500 + 50	64.85	36.17	67.58	59.85	54.78	28.03	16.55	36.37	75.16	73	67.19	72.45	67.58

DAS= Days after spray, M- Mean

SN.	Treatment	Dose ml or g/ha	Population after compilation of three sprays (DAS) during 2023													
			Coccinellid/ 5 plants								Chrysopa/ 5 Plants					
			BS				7				10				Spider/ 5 plants	
			OV	TV	OV	TV	OV	TV	OV	TV	OV	TV	OV	TV	OV	TV
1	T1	-	0	0	0	0	0	0	0	0	2.40	1.70	2.00	1.58	2.21	1.65
2	T2	250 g	0	0	0	0	0	0	0	0	2.30	1.67	1.80	1.52	2.17	1.63
3	T3	312.5g	0	0	0	0	0	0	0	0	2.10	1.61	1.60	1.45	2.15	1.63
4	T4	375 g	0	0	0	0	0	0	0	0	2.20	1.63	1.70	1.46	2.11	1.60
5	T5	750 g	0	0	0	0	0	0	0	0	2.10	1.61	1.40	1.38	1.71	1.49
6	T6	375	0	0	0	0	0	0	0	0	2.30	1.67	1.70	1.48	2.01	1.58
7	T7	1000	0	0	0	0	0	0	0	0	2.00	1.58	0.90	1.18	1.21	1.31
S.Em ±											0.07		0.08		0.07	0.08
CD at 5%											0.23		0.26		0.23	0.24
CV %											5.84		7.47		6.27	6.82

**Table 5:** A Effect of different treatments on natural enemies on cotton after compilation of I<sup>st</sup> spray, II<sup>nd</sup> & III rd spray

SN.	Treatment	Dose ml or g/ha	Population after compilation of three sprays (DAS) during 2024													
			Coccinellid/ 5 plants								Chrysopa/ 5 Plants					
			BS				7				10				Spider/ 5 plants	
			OV	TV	OV	TV	OV	TV	OV	TV	OV	TV	OV	TV	OV	TV
1	T1	-	0	0	0	0	0	0	0	0	2.30	1.67	1.90	1.55	2.11	1.62
2	T2	250 g	0	0	0	0	0	0	0	0	2.20	1.64	1.70	1.48	2.07	1.60
3	T3	312.5	0	0	0	0	0	0	0	0	2.00	1.58	1.50	1.41	2.05	1.60
4	T4	375 g	0	0	0	0	0	0	0	0	2.10	1.60	1.58	1.42	2.08	1.59
5	T5	750 g	0	0	0	0	0	0	0	0	2.00	1.58	1.30	1.34	1.61	1.45
6	T6	375	0	0	0	0	0	0	0	0	2.20	1.64	1.60	1.45	1.91	1.55
7	T7	1000	0	0	0	0	0	0	0	0	1.90	1.55	0.80	1.14	1.11	1.27
S.Em ±											0.09		0.09		0.08	0.04
CD at 5%											0.23		0.26		0.23	0.12
CV %											6.07		7.92		6.43	4.47

### Seed Cotton Yield

Seed cotton yield was observed higher in all the insecticidal treated plots over untreated ranging from (8.49 to 12.74 and 11.92 to 18.17 q/ha) during *kharif* 2023 and 2024 respectively. Highest seed cotton yield was recorded in the

plots treated with Spidoxamat 9.6 % + Spinetoram 12% WG @ 45 a.i /ha 12.74 and 18.17 q/ha, respectively of the both years, with the increase percent over the control was 50.06 & 52.43 %) respectively followed by same products with the

312.5 ml/ha that is 11.77 and 17.20 q/ha during *kharif* 2023 & *kharif* 2024 as shown in the table 6

**Table 6:** Yield under the different treatments against thrips/whitefly in cotton during *Kharif*-2023 & 2024

S. No.	Treatment	Dosage (ml or gm/ha)		Yield (q/ha)					
		a.i. (g)	Formulation (g / ml)	2023		2024		Polled Mean	
1.	Untreated control	-	-	8.49	0.00	11.92	0.00	10.205	0.00
2.	Spidoxamat 9.6 % + Spinetoram 12% WG	24 +30	250 g	10.42	22.73	15.85	32.97	13.135	28.71
3.	Spidoxamat 9.6 % + Spinetoram 12% WG	30 +37.5	312.5 g	11.77	38.63	17.20	44.30	14.485	41.94
4.	Spidoxamat 9.6 % + Spinetoram 12% WG	36 + 45	375 g	12.74	50.06	18.17	52.43	15.455	51.45
5.	Spidoxamat 4.8% WG	36	750g	11.55	36.04	16.98	42.45	14.265	39.78
6.	Spinetoram 11.70 %SC	45	375 ml	11.18	31.68	16.61	39.35	13.895	36.16
7.	Chlorpyrifos 50 % + Cypermethrin 5 % EC	500 + 50	1000 ml	10.40	22.50	15.83	32.80	13.115	28.52
8.	Spidoxamat 9.6 % + Spinetoram 12% WG	72 + 90	750 g	8.49	0.00	11.92	0.00	10.205	0.00

#### 4. Conclusion

It can be concluded that, Spidoxamat 9.6 % + Spinetoram 12% WG a.i. 36 +45 a.i. /ha @ 375 g/ha. was found effective for the control of thrips and whitefly which was at par with the doses of the chemical a.i 30 +37.5 @ 312.5 g/ha. Therefore, the effective dose of the chemicals 36 +45 a.i. /ha @ 375 g/ha was efficient to control thrips and whitefly on cotton during 2023 & 2024 and was found relatively safer to the natural enemies population and good yield production point of view and noticed non phototoxic to the cotton crop similarly result observed by Srinivasan et al., (2019) spinetoram 10% + sulfoxaflor 30% WG @300 ml/ha were superior and effective in reducing the flea beetle damage which also contributed higher fruit yield and Cost-Benefit Ratio. Srinivasan and Kalyanasundaram (2019) reported that three sprays of spinetoram 10 % w/w + sulfoxaflor 30 % w/w WG @ 140 g a.i/ha were effective and superior in reducing leaf hopper damage on okra and contributed higher fruit yield and cost benefit ratio which is in agreement with our present findings on grapevine against *S.strigicollis*. Sushila N. et al., (2024) observed lowest larval population of DBM and Cabbage Semilooper was registered on cabbage crop in Spinetoram 12% SC w/v (11.7% w/w) SC @ 54 g a.i/ha with 1.58 and 1.89 larvae per plant 14 days after first and second treatment imposition, respectively. Similarly, significantly lowest larval population was recorded in the treatment Spinetoram 12% SC w/v (11.7% w/w) SC @ 54 g a.i/ha with 0.62 and 0.69 larvae/plant respectively. Paper cent head damage revealed that the test compound Spinetoram 12% SC w/v (11.7% w/w) SC @ 54 g a.i/ha recorded lowest head damage with 1.62% at Spinetoram 12% SC w/v (11.7% w/w) SC @ 54 g a.i/ha and get highest yield of 21.98 tons per ha. Guruprasad et al., (2019) observed that spinetoram 12% SC @ 300 and 375 g.a.i/ ha found to be effective in reducing the thrips population and also for realising the higher fruit yield with a least adverse effect on natural enemies build up like coccinellids.

#### Acknowledgement

The authors acknowledge ARS, Sri Ganganagar for conducting experimental trails for two consecutive years and helpful Dr Pradeep Kumar (Co-PI of trail), Dr N.K. Sharma (PI of cotton) and Sh Pawan Kumar for conducting research trial and helped by Dr. Pradeep Kumar and Dr N.K. Sharma for the guiding and encourage for the preparation of the research paper.

#### References

- [1] Website <https://caionline.in/> (2024) Cotton Association of India.
- [2] Sparks, T.C., G.D. Thompson, H.A. Kirst, M.B. Hertlein, L.I. Larson, T.V. Worden and S.T. Thibault (1998). Biological Activity of the Spinosyns, New Fermentation Derived Insect Control Agents, on Tobacco Budworm (Lepidoptera: Noctuidae) larvae. *J. Econ. Entomol.*, 91(6):1277-1283.
- [3] Srinivasan, G, Chinniah, C., Kalyanasundaram, M and Shanthi, M. (2019). Evaluation of spinetoram and sulfoxaflor against Flea beetle, *Scelodonta strigicollis* Motschulsky on Grapevine. *Madras Agric. J.*, 106 (7-9): 537 – 541
- [4] Srinivasan, G. and M. Kalyanasundaram. (2019). Efficacy of spinetoram 10 % w/w + sulfoxaflor 30 % w/w WG against leaf hopper, *Amrasca biguttula biguttula* Ishida on okra. *Green Farming*, 10: 217-221
- [5] Sushila N., Basavaraj S.K., Shivaleela G., Chandana C.R., Hadimani D.K. and Sanganna S., (2024). Bio-efficacy, phytotoxicity and effect on natural enemies of spinetoram 12% SC w/v (11.7% w/w) SC against lepidopteran insect pests of cabbage. *International Journal of Advanced Biochemistry Research* 8 (6): 802-807
- [6] Guruprasad GS, Shivayogiyappa, Gangaraju P, Rajeevkumar N., Prameshand D. and Goudar SB (2019). Efficacy of Spinetoram 12% SC against thrips on grape. *Journal of Entomology and Zoology Studies* 7 (6) : 746 -749.