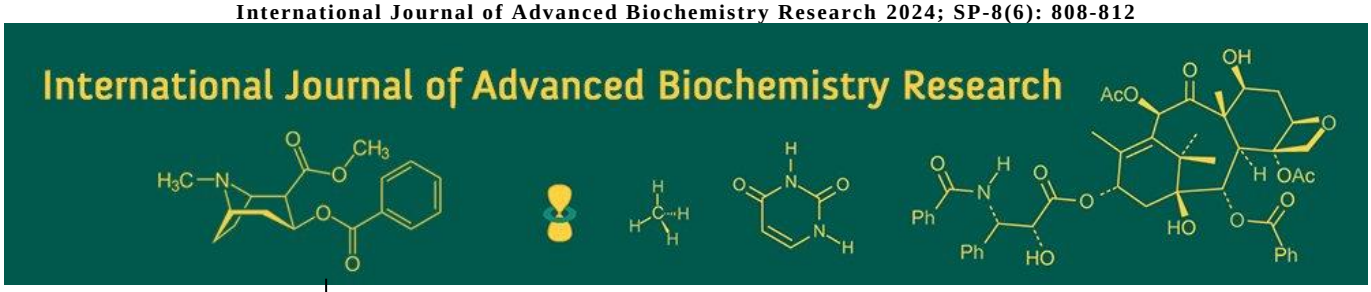

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Dr. Shivaleela Gouda
Associate Professor, Department of Entomology, College of Agriculture, Raichur, Karnataka, India

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

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

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

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

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

Corresponding Author:
Dr. Shivaleela Gouda
Associate Professor, Department of Entomology, College of Agriculture, Raichur, Karnataka, India

Bio-efficacy and effect on natural enemies of sulfoxaflor 12% SC W/V against aphids in cotton ecosystem

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

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Abstract
Cotton aphid, *Aphis gossypii* Glover (Homoptera: Aphididae) is one of the important pest of cotton, have been causing severe damage and yield loses. Several insecticides developed resistance against *Aphis gossypii*, hence, there is a need to identify the newer insecticide having unique mode of action to control aphids in cotton ecosystem. The present study aimed to evaluate the bio-efficacy, phytotoxicity and effect on natural enemies of Sulfoxaflor 12% SC w/v against aphids in cotton crop. The results revealed that, lowest population of aphids at seven days after treatment was recorded in the highest dosage of Sulfoxaflor 12% SC @ 250 ml/ha which recorded 0.87 aphids per leaf followed by next dosage of Sulfoxaflor 12% SC @ 225 ml/ha. Similarly, the lowest population of aphids was recorded in the highest dosage of Sulfoxaflor 12% SC @ 250 ml/ha (0.55 aphids per leaf), next treatment was Sulfoxaflor 12% SC @ 225 ml/ha (2.56 per leaf) seven days after second spray. Significantly highest yield of 20.46 q/ha was recorded with Sulfoxaflor 12% SC @ 250 ml/ha which was on par with Sulfoxaflor 12% SC @ 225 ml/ha (19.76 q/ha). The test chemical Sulfoxaflor 12% SC did not affect the natural enemies like coccinellids and spiders indicated that, Sulfoxaflor 12% SC were safe to natural enemies. Sulfoxaflor 12% SC at all dosages did not record any phytotoxic symptoms on cotton plants.

Keywords: Bio-efficacy, phytotoxicity, coccinellids, spiders, natural enemies, sulfoxaflor 12% SC

Introduction
Cotton (*Gossypium hirsutum* L.) is one of the commercially most important fibre crops in the world. It is popularly known as "White gold" or "King of fibre" because of its global significance. It is grown as an annual crop. Cotton is subjected to damage by 162 species of pests right from germination till the final picking (Dhaliwal and Arora, 1998) [5]. In India cotton crop known to be attacked by 162 species of insects pests from sowing to harvesting and which causes loss up to 50-60 per cent (Agarwal *et al*, 1984) [1]. The major factor responsible for the low productivity and quality deterioration of cotton is the severe attack of insects/pests from sowing to harvesting. Large area under rainfed situation and extensive replacement of conventional varieties with superior hybrids made the crop easily vulnerable to insect pests. There are many insect pests damages the cotton crop, that includes bollworms, sap sucking insects, red cotton bug, dusky cotton bug, defoliators, leaf rollers etc. Among them sucking pests, aphids, *Aphis gossypii* (Glover), leafhoppers, *Amrasca biguttula biguttula* (Ishida), thrips, *Thrips tabaci* (Lind.) and whiteflies, *Bemisia tabaci* (Genn.) are of major importance. These sucking pests occurs at all the stages of crop growth and responsible for indirect yield losses. A reduction of 22.85 per cent in seed cotton yield due o sucking pests has been reported by Satpute *et al* (1991) [1]. Sucking pests also referred to a "sap feeders", limit the realization of the potential productivity of cotton, they are deleterious to the cotton plant growth and development by being assimilated sappers, stand reducers and light stealers. The heavy infestation of nymphs and adults of sucking pests resulted in leaf yellowing, wrinkled leaves and leaf distortion. They also secret the honey dew which leads to the growth and development of sooty mould fungus (*Capnodium* sp.) on leaves. The fungus inhibits the photosynthetic activity of the plants resulting into chlorosis that affect the seed cotton yield.

Cotton aphids are the most serious pests of cotton all over the world (Rummel *et al* 1995; Akey and Butler, 1989) [8, 2] reported that cotton aphid has the potential to be a serious pest of cotton in any season due its severe outbreaks. It is an important pest in agriculture, horticulture and greenhouse crops. Most common agricultural insect pest is the cotton aphid, *Aphis gossypii* Glover (Homoptera: Aphididae) and it reduces the yield and quality of cotton. Cotton aphids injure cotton plants by continually feeding on fluids in plant phloem tubes. This feeding can stimulate foliar alterations, delay of the plant growth, fewer fruit setting, lower fruit retention and reduced cotton lint weight (Raboudi *et al*, 2002) [7]. There are various types of agricultural insecticides have been developed to date. However, there are many cases of emergence of resistant insect pests against various insecticides due to long-term use or continuous application of insecticides for crop protection. In order to overcome such resistance development, it is generally recommended to implement rotation programs which include some insecticides with different modes of action. Keeping these points in view it was tried to find out the effective chemicals for the management of sucking pests in cotton.

Materials and Methods

Evaluation of Sulfoxaflor 12% SC w/v against sap sucking insects cotton aphid *Aphis gossypii* was undertaken in an experimental block at Agricultural Research Station, Raichur during the year 2022-23. The experiment was laid out in a randomized block design (RBD) with three replications. The test molecule, Sulfoxaflor 12% SC w/v was tested at three different dosages *viz*., 200, 225, 250 ml/hectare for its efficacy against insects cotton aphid *Aphis gossypii* and at 30 gai/hectare for its phytotoxicity evaluation. This was compared with two standard checks *viz.*, Imidacloprid 17.8% SL and Acetamiprid 20% SP along with an untreated control against cotton aphid *Aphis gossypii*. Treatments were imposed two times based on pest population build-up (above ETL). All the agronomic practices were followed as per recommended package of practices of UAS Raichur. Observations on cotton aphid *Aphis gossypii* were taken from randomly selected and tagged five plants in each treatment to record aphids population. The population of aphids were recorded on five leaves in each plant in each treatment and population was converted to number per leaf. The observations were recorded one day before spray (DBS), one, three, seven, ten and fourteen days after spray (DAS). The data was averaged and converted to per leaf for all the sprays and analyzed statistically for their significance. After each application observation were recorded at: DBA, 1DAA, 3DAA, 7DAA, 10DAA and 14DAA and were recorded in 5 leaves per plant and 5 plants/ replication and later it was converted aphid population into per leaf and % reduction over control will be computed. 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. Observations on natural enemies (Parasites and predators) like coccinellids, Spiders, *Chrysopa* etc. were recorded on one day before application (Pre-treatment) per plant, and at subsequently at 1, 3, 5, 7 and 10 days after each application**.** 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.

Observations on phytotoxicity

Observations on phytotoxicity symptoms, if any from 10 plants in each treatment at 0, 1, 3, 5, 7 and 10 days after each application and observations on, Leaf injury on tips and leaf surface, Wilting, Vein clearing, Necrosis, Epinasty and hyponasty were recorded.

Score	Phytotoxicity (%)
0	No Phytotoxicity
1	0-10
2	Nov-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

Bioefficacy of Sulfoxaflor 12% SC against cotton aphid *Aphis gossypii* (After fist spray)

During the first spray, among the treatments population of aphids a day before spray ranged in between 12.00 and 12.99 per leaf and were non-significant. A day after spray the lowest aphids population with 5.23 per leaf was recorded in highest dosage of Sulfoxaflor 12% SC @ 250 ml/ha followed by its next dosage treatment of Sulfoxaflor 12% SC @ 225 ml/ha (7.67 aphids/leaf). The treatment Sulfoxaflor 12% SC @ 200 ml/ha, Acetamiprid 20% SP @ 50g/ha and Imidacloprid 17.8% SL @ 125 ml/ha recorded 9.35, 9.67 and 9.81 aphids per leaf and were on par with each other. At three days after spray the treatments Sulfoxaflor 12% SC @ 250 ml/ha and 225 ml/ha recorded 1.51, 2.39 aphids per leaf, respectively. The lowest dosage of Sulfoxaflor 12% SC @ 200 ml/ha (3.99 aphids/leaf) was on par with Acetamiprid 20% SP @ 50g/ha and Imidacloprid 17.8% SL @ 125 ml/ha (Table 1).

Lowest population of aphids at seven days after treatment was recorded in the highest dosage of Sulfoxaflor 12% SC @ 250 ml/ha which recorded 0.87 aphids per leaf followed by next dosage of Sulfoxaflor 12% SC @ 225 ml/ha which recorded aphids population of 2.18 per leaf. Sulfoxaflor 12% SC @ 200 ml/ha, Acetamiprid 20% SP @ 50 g/ha and Imidacloprid 17.8% SL @ 125 ml/ha were on par with each other which recorded aphids population of 3.42, 3.63 and 3.72 aphids per leaf, respectively. Aphids population at ten days after spray increased but the highest dosage of Sulfoxaflor 12% SC @ 250 ml/ha maintained its superiority in reducing the aphids population (1.03 aphids/ leaf) followed by this was Sulfoxaflor 12% SC @ 225 ml/ha. Population of aphids at fourteen days after spray gradually increased in all the treatments (Sulfoxaflor 12% SC treatments at different doses and Imidacloprid 17.8% SL) and untreated control which recorded 15.84 aphids per leaf respectively (Table 1 & 2).

Bioefficacy of Sulfoxaflor 12% SC against cotton aphid *Aphis gossypii* (After second spray)

A day after spray the lowest aphids population with 3.16 per leaf was recorded in highest dosage of Sulfoxaflor 12% SC

@ 250 ml/ha followed by its next dosage treatment of Sulfoxaflor 12% SC @ 225 ml/ha (5.60 aphids/leaf). Sulfoxaflor 12% SC @ 200 ml/ha, Acetamiprid 20% SP @ 50 g/ha and Imidacloprid 17.8% SL @ 125 ml/ha recorded 7.28, 7.60 and 7.74 aphids per leaf and were on par with each other. At three days after spray the treatments Sulfoxaflor 12% SC @ 250 ml/ha and 225 ml/ha recorded 0.97, 1.82 aphids per leaf, respectively. The lowest dosage of Sulfoxaflor 12% SC @ 200 ml/ha (3.02 aphids/leaf) was on par with Acetamiprid 20% SP @ 50 g/ha (3.19 aphids/leaf) and Imidacloprid 17.8% SL @ 125 ml/ha (3.27 aphids/leaf). Untreated control recorded aphids population of 17.78 aphids per leaf (Table 3&4).

At seven days after spray lowest population of aphids was recorded in the highest dosage of Sulfoxaflor 12% SC @ 250 ml/ha which recorded 0.55 aphids per leaf and next dosage of Sulfoxaflor 12% SC @ 225 ml/ha which recorded aphids population of 2.56 per leaf. Sulfoxaflor 12% SC @ 200 ml/ha, Acetamiprid 20% SP @ 50 g/ha and Imidacloprid 17.8% SL @ 125 ml/ha were on par with each other. At ten days after spray aphids population increased but Sulfoxaflor 12% SC @ 250 ml/ha maintained its superiority in reducing the aphids population (0.86 aphids/ leaf) followed by its lower dose treatment of Sulfoxaflor 12% SC @ 225 ml/ha (3.03 aphids/leaf). The population of aphids increased in all the treatments and were on par with each other at fourteen days after spray. Whereas, untreated control which recorded 15.95 aphids per leaf (Table 3&4).

Effect of Sulfoxaflor 12% SC on yield parameters

Among the treatments tested recorded significantly higher seed yield when compared to untreated control. The highest yield of 20.46 q/ha was recorded with Sulfoxaflor 12% SC @ 250 ml/ha. This was followed by the treatment with Sulfoxaflor 12% SC @ 225 ml/ha (19.76 q/ha). Sulfoxaflor 12% SC @ 200 ml/ha and Acetamiprid 20% SP @ 125 ml/ha were on par with each other which recorded yield of 19.20 and 19.10 q/ha respectively. The lowest yield 12.42 q/ha) was recorded in the untreated control (Table 3).

Effect of Sulfoxaflor 12% SC on predatory population

Population of coccinellids a day before spray ranged from 1.29 to 1.35 adults per plant during first spray and there was no significant difference among the treatments at three, five and ten days after spray where the population of coccinellids were statistically on par with each other. Similarly, during the second spray population of coccinellids a day before were statistically non-significant and ranged from 1.63 to 1.69 per plant and after ten days of spray population of coccinellids were statistically on par with each other (1.75 to 2.02/plant) (Table 5). Similarly the population of spiders a day before first spray among different treatments were non-significant which ranged between 1.38 to 1.44 per plant. At three, five, seven and ten days after first spray the population of spiders were on par with each other and were non-significant. During second spray the population of spiders a day before among different treatments ranged from 1.26 to 1.32 per plant and were statistically non-significant. Ten days after spray population of coccinellids were statistically on par with each other (1.16 to 1.37/plant) (Table 6).

Effect of Sulfoxaflor 12% SC on phytotoxicity

The crop was visually observed for the phytotoxic symptoms sprayed with Sulfoxaflor 12% SC 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 Sulfoxaflor 12% SC @ 60 g.a. i./ha.

The present study was in conformity with the reports of Katare *et al* (2022) [6] evaluated efficacy of sulfoxaflor 12%SC for the control of aphids at Haryana. The incidence of aphids was significantly less with sulfoxaflor 12 SC @ 24, 27 and 30 g a.i./ ha with 94.54, 95.27 and 96.03% reduction, respectively, these being at par with each other, followed by thiamethoxam 25WDG @ 12.5 g a.i./ ha and quinalphos 25EC @ 250 g a.i./ ha. The seven-spotted ladybird beetle *Coccinella septempunctata* L. was the main natural enemy observed in the crop, and its counts were the least (1.50/ m2) with thiamethoxam 25WDG @ 12.5 g a.i./ha at 14 DAS. The pooled data revealed that the yield was significantly more with sulfoxaflor 12SC @ 24, 27 and 30 g a.i./ ha (52.21, 52.62 and 54.32 q/ ha) followed by thiamethoxam 25WDG @ 12.5 g a.i./ ha (49.87 q/ ha) which was at par with quinalphos 25EC @ 250 g a.i./ ha (47.73 q/ha). Considering incremental cost benefit ratio, sulfoxaflor 12% SC @30 g a.i/ ha (1:2.70) is the most economical and no phytotoxicity symptoms were observed at its doses @30 and 60 g a.i/ ha.

The results are also in line with the reports of Siebert *et al* (2012) [10], who evaluated the efficacy of sulfoxaflor against different plant bugs compared to acephate, the most widely used insecticide in cotton. Across infestation levels (12 locations, 49 trials), sulfoxafor applied at ≥ 50 g ai/ ha provided control and yield levels similar to that observed with acephate. Against moderate infestations, single applications of sulfoxafor (≥ 50 gai/ha) or acephate reduced infestations below the action threshold 64 to 83% of the time through 8 days after application. Two applications of these same treatments and application timings against high infestations resulted in frequencies below the action threshold of 71 to 93%. Number of nymphs did not significantly differ between application of 50 and 75 g ai/ha of sulfoxaflor and acephate within single or sequential timings. Routine scouting practices will be necessary in determining the timing of insecticide treatments following a sulfoxaflor application. The new mode of action and efficacy provided by sulfoxaflor can be incorporated in cotton integrated pest management programs for tarnished plant bug that utilizes multiple insecticides. Similarly Chandi (2019) [3] evaluated the efficacy of sulfoxaflor 12 SC for the control of aphids in wheat crop at Ludhiana. The population of aphids was significantly lowest in sulfoxaflor 12 SC @ 24, 27 and 30 g a.i./ha, being at par with each other and standard thiamethoxam 25 WDG @ 12.5 g a.i./ha and quinalphos 25 EC @ 250 g a.i./ha followed by sulfoxaflor 12 SC @ 21 g a.i./ha. Among all the treatment, significantly higher yield was obtained in sulfoxaflor 12 SC @ 24, 27 and 30 g a.i./ha (44.55, 44.77 and 45.00 q/ha) and was at par thiamethoxam 25 WDG @ 12.5 g a.i./ha (44.47 q/ha) and quinalphos 25 EC @ 250 g a.i./ha (44.22 q/ha). Similarly, Chinniah *et al* (2019) [4] evaluated combination products spinetoram 10% w/w WG + sulfoxaflor 30% w/w WG against Grapevine thrips, *Rhipiphorothrips cruentatus* in TN. Three rounds of foliar application of spinetoram 10% w/w WG + sulfoxaflor 30% w/w WG @350 ml/ha and spinetoram 10% WG+ sulfoxaflor 30% WG @ 300 ml/ha

were superior and effective in reducing the thrips damage on leaves and berries, which also recorded higher fruit yield and Cost-Benefit Ratio.

However contrasting results were observed as reported by Skouras *et al* (2023) [11] who studied the ecological toxicity of the insecticide to the coccinellid predator at sublethal and lethal doses and examined the influence of sulfoxaflor on larvae of *H. variegata* using exposure doses of 3, 6, 12, 24, 48 (Maximum recommended field rate (MRFR)), and 96 ng a.i. per insect. The results present a negative influence of sulfoxaflor on *H. variegata* when applied at the recommended field dose for controlling aphids in Greece, which demonstrates that this insecticide may only be employed with care when used in IPM programs.

Table 1: Efficacy of Sulfoxaflor 12% SC against aphids in cotton during 2022-23, *Kharif* season (First Spray)

Sl. No.	Treatments	Formulation (ml/ha)	Dose (g ai/ha)	Aphids/ leaf					
				1DBS	1 DAS	3DAS	7 DAS	10 DAS	14 DAS
1	Sulfoxaflor 12% SC	200	24	12.99	9.35 (3.14)	3.99 (2.12)	3.42 (1.98)	5.55 (2.46)	9.90 (3.22)
2	Sulfoxaflor 12% SC	225	27	12.42	7.67 (2.86)	2.39 (1.70)	2.18 (1.64)	2.69 (1.79)	9.85 (3.22)
3	Sulfoxaflor 12% SC	250	30	12.00	5.23 (2.39)	1.51 (1.42)	0.87 (1.17)	1.03 (1.24)	8.80 (3.05)
4	Imidacloprid 17.8% SL	125	25	11.90	9.81 (3.21)	4.24 (2.18)	3.72 (2.05)	5.81 (2.51)	11.45 (3.46)
5	Acetamiprid 20% SP	50	10	12.80	9.67 (3.19)	4.16 (2.16)	3.63 (2.03)	5.77 (2.50)	10.25 (3.28)
6	Untreated control		--	12.40	14.75 (3.91)	16.47 (4.12)	17.13 (4.20)	19.14 (4.43)	15.84 (4.04)
S.Em ±				0.52	0.06	0.03	0.05	0.07	0.12
CD at 5%				NS	0.17	0.10	0.15	0.19	0.38
CV (%)				16.26	11.33	10.65	13.12	12.54	14.15

DBS: Day before spray DAS: Day after spray
*Figures in parentheses are square root transformed values

Table 2: Efficacy of Sulfoxaflor 12% SC against aphids in cotton during 2022-23, *Kharif* season (First Spray) (Per cent reduction over control)

Sl. No.	Treatments	Formulation (ml/ha)	Dose (g ai/ha)	Aphids (% Reduction over control)				
				1 DAS	3DAS	7 DAS	10 DAS	14 DAS
1	Sulfoxaflor 12% SC	200	24	36.6	75.8	80.0	71.0	37.5
2	Sulfoxaflor 12% SC	225	27	48.0	85.5	87.3	85.9	37.8
3	Sulfoxaflor 12% SC	250	30	64.5	90.8	94.9	94.6	44.4
4	Imidacloprid 17.8% SL	125	25	33.5	74.3	78.3	69.6	27.7
5	Acetamiprid 20% SP	50	10	34.4	74.7	78.8	69.9	35.3
6	Untreated control	--	--	0.00	0.00	0.00	0.00	0.00

Table 3: Efficacy of Sulfoxaflor 12% SC against aphids in cotton during 2022-23, *Kharif* season (Second Spray)

Sl. No.	Treatments	Formulation (ml/ha)	Dose (gai/ha)	Aphids/ leaf						Yield (q/ha)
				1DBS	1 DAS	3DAS	7 DAS	10 DAS	14 DAS	
1	Sulfoxaflor 12% SC	200	24	9.90	7.28 (2.79)	3.02 (1.88)	2.85 (1.83)	3.25 (1.94)	8.77 (3.04)	19.20
2	Sulfoxaflor 12% SC	225	27	9.85	5.60 (2.47)	1.82 (1.52)	2.56 (1.75)	3.03 (1.88)	8.54 (3.01)	19.76
3	Sulfoxaflor 12% SC	250	30	8.80	3.16 (1.91)	0.97 (1.21)	0.55 (1.02)	0.86 (1.17)	3.58(2.02)	20.46
4	Imidacloprid 17.8% SL	125	25	11.45	7.74 (2.87)	3.27 (1.94)	3.27 (1.94)	4.89 (2.32)	9.15 (3.11)	18.94
5	Acetamiprid 20% SP	50	10	10.25	7.60 (2.85)	3.19 (1.92)	3.56 (2.01)	5.05 (2.36)	9.28 (3.13)	19.10
6	Untreated control	--	--	15.84	16.33 (4.10)	17.78 (4.28)	15.23 (3.97)	15.95 (4.06)	14.57 (3.88)	12.42
S.Em ±				0.25	0.04	0.07	0.05	0.03	0.16	0.21
CD at 5%				0.77	0.12	0.18	0.15	0.10	0.49	0.64
CV (%)				14.68	11.23	13.14	11.67	10.87	13.52	13.87

DBS: Day before spray DAS: Day after spray
*Figures in parentheses are square root transformed values

Table 4: Efficacy of Sulfoxaflor 12% SC against aphids in cotton during 2022-23, *Kharif* season (Second Spray) (Per cent reduction over control)

Sl. No.	Treatments	Formulation (ml/ha)	Dose (g ai/ha)	Aphids (% Reduction over control)				
				1 DAS	3DAS	7 DAS	10 DAS	14 DAS
1	Sulfoxaflor 12% SC	200	24	55.42	83.01	81.29	79.62	39.81
2	Sulfoxaflor 12% SC	225	27	65.71	89.76	83.19	81.00	41.39
3	Sulfoxaflor 12% SC	250	30	80.65	94.54	96.39	94.61	75.43
4	Imidacloprid 17.8% SL	125	25	52.60	81.61	78.53	69.34	37.20
5	Acetamiprid 20% SP	50	10	53.46	82.06	76.63	68.34	36.31
6	Untreated control	--	--	0.00	0.00	0.00	0.00	0.00

Table 5: Bioefficacy of Sulfoxaflor 12% SC against natural enemies in cotton *Kharif*, 2022-23

Sl. No	Treatments	Formulation (ml/ha)	Dose (g ai/ha)	Coccinellids (adults / plant)									
				First spray					Second spray				
				1 DBS	3 DAS	5 DAS	7 DAS	10 DAS	1 DBS	3 DAS	5 DAS	7 DAS	10 DAS
1	Sulfoxaflor 12% SC	200	24	1.29	1.10	1.32	1.41	1.47	1.69	1.52	1.65	1.73	1.81
2	Sulfoxaflor 12% SC	225	27	1.35	1.14	1.33	1.38	1.42	1.67	1.56	1.71	1.70	1.79
3	Sulfoxaflor 12% SC	250	30	1.30	1.11	1.30	1.41	1.39	1.64	1.48	1.63	1.73	1.76
4	Imidacloprid 17.8% SL	125	25	1.33	1.08	1.24	1.37	1.38	1.65	1.51	1.62	1.69	1.75
5	Acetamiprid 20% SP	50	10	1.29	1.14	1.28	1.43	1.39	1.63	1.56	1.66	1.75	1.76
6	Untreated control	--	--	1.33	1.40	1.52	1.65	1.57	1.66	1.75	1.87	1.99	2.02
S Em ±				0.26	0.31	0.25	0.33	0.42	0.20	0.18	0.21	0.25	0.28
CD (P=0.05)				NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

DBS: Day before spray DAS: Day after spray

Table 6: Bioefficacy of Sulfoxaflor 12% SC against natural enemies in cotton *Kharif*, 2022-23

Sl. No	Treatments	Formulation (ml/ha)	Dose (g ai/ha)	Spiders (adults/ plant)									
				First spray					Second spray				
				1 DBS	3 DAS	5 DAS	7 DAS	10 DAS	1 DBS	3 DAS	5 DAS	7 DAS	10 DAS
1	Sulfoxaflor 12% SC	200	24	1.41	1.30	1.19	1.27	1.38	1.26	1.11	1.00	1.12	1.23
2	Sulfoxaflor 12% SC	225	27	1.44	1.33	1.17	1.24	1.34	1.30	1.15	1.01	1.12	1.21
3	Sulfoxaflor 12% SC	250	30	1.39	1.30	1.14	1.25	1.36	1.27	1.12	0.98	1.09	1.18
4	Imidacloprid 17.8% SL	125	25	1.38	1.27	1.10	1.17	1.28	1.30	1.09	0.94	1.09	1.20
5	Acetamiprid 20% SP	50	10	1.39	1.32	1.16	1.23	1.32	1.27	1.15	0.96	1.07	1.16
6	Untreated control		--	1.43	1.55	1.48	1.55	1.61	1.32	1.38	1.25	1.30	1.37
S Em ±				0.17	0.13	0.18	0.21	0.16	0.11	0.18	0.21	0.15	0.12
CD (P=0.05)				NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

DBS: Day before spray DAS: Day after spray

Conclusions

Sulfoxaflor 12% SC at 250 ml/ha (30 g ai/ha) treatment was found to be optimum and effective in reducing aphids population with higher yield in cotton. The predatory population (coccinellids and spiders) didn't show any significant difference among treatments indicating that, all the dosages of Sulfoxaflor 12% SC were safe to natural enemies. Sulfoxaflor 12% SC at all dosages, application did not record any phytotoxic symptoms on cotton plants.

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