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Efficacy of novel insecticides against sucking pests and bollworms of cotton

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Abstract
To assess the efficacy of different insecticides for the management of sucking pests and bollworms of cotton, an experiment was conducted at MARS Raichur during 2017-18. Among the different tested insecticides Spinetoram 10%+ Sulfoxaflor 40%WG @ 140 g.a.i/ha has shown 84.67 per cent reduction of leafhopper population and 8.50 per cent reduction of thrips over control. The population of bollworms *i.e. Helicoverpa Armigera* and *Pectinophora gossipella* seven days after treatment with Sulfoxaflor 40%WG @ 140 g.a.i/ha was 0.39 and 2.27 larvae/plant respectively, which was the lowest compared to rest of the treatments. Furthermore, it has recorded highest yield of 14.27 q/ha when compared to other treatments.

Keywords: Cotton, sucking pests, bollworms, insecticides, efficacy

Introduction
Cotton, *Gossypium hirsutum* L. (Family: Malvaceae) is one of the major cash crops of global significance. In India it is grown in an area of about 10.2 m ha with a production of 32.5 million bales. It is an important raw material for several agro-based industries of Asia. Thus it sustains millions of the people for livelihood at farms, ginning factories, textile mills, edible oil and soap industries *etc*. hence regarded as lifeblood of economy of many countries in Asia. Cotton yield has been limited by 162 insect pest and diseases. Out of which 93 insect pests and mites are reported to infest cotton crop [1].
The insect pests of cotton can be broadly divided into two groups as sucking insect pests [whitefly, *Bemisia tabaci* (Gennadius); leafhoppers, *Amrasca devastans* (Ishida, 1912) and thrips, *Thrips tabaci* (Lindeman) etc.) and bollworms (spotted bollworm, *Earias insulana* (Boisduval, 1833), American bollworm, *Helicoverpa Armigera* (Hübner), Pink bollworm, *Pectinophora gossipella* (Saunders) etc. [3]]. Sucking pests apart from sucking the sap from the under surface of the leaves also transmit viral diseases. Among bollworms *P. gossypiella* has once again taken upper hand and damage to cotton in Central and South India. Insecticides are part of pest management and keep pest populations below ETL in better and quick successions, there by yield can be increased. Therefore with a view to find efficacy of new novel insecticides and their combination this experiment has been conducted against sucking pests and bollworms.

Materials and method:
Crop was raised as per the recommended package of practice. Five plants per replication were selected and tagged for recording the observation in each treatment. The number of thrips and leafhoppers were counted on top growing three leaves from each plant. Population count was made on one day before spray and 7 days after 1st, 2nd and 3rd sprays respectively. Second and third spray was taken whenever pest population crossed ETL. The mean population per three leaves per plant was recorded and subjected to statistical analysis. With respect to *Helicoverpa armigera* number of larvae were counted on five randomly selected plants and converted to larvae per plant. Whereas, observation on pink bollworm was recorded by collecting ten bolls from each plant from five randomly selected plants later converted to larvae per ten bolls.

Treatment details

S. No.	Insecticide	Dose (g ai/ha)	Formulation (ml or g/ha)
1	Spinetoram 10%+ Sulfoxaflor 40%WG	120	300
2	Spinetoram 10%+ Sulfoxaflor 40%WG	140	350
3	Spinetoram 12%SC	30	250
4	Sulfoxaflor 24%SC	90	375
5	Spinetoram 12%SC	36	350
6	Sulfoxaflor 24%SC	108	350
7	Pyriproxyfen 5% + Fenpropathrin 15% EC	37.5+112.5	750
8	Pyriproxyfen 5% EC	37.5	750
9	Fenpropathrin 15% EC	112.5	750
10	Control (Unsprayed)	--	--
11	Control (water spray)	--	--

Results

Leafhoppers: Population of leafhoppers a day before spray at the time of first treatment imposition ranged from 11.45 to 13.90 per three leaves and there was no significant difference between the treatments. Mean number of leafhoppers a day before first treatment was 9.91/plant. Significantly lowest leafhopper population after seven days of first spray was recorded in Spinetoram 10%+ Sulfoxaflor 40%WG @ 140 g.a.i/ha (1.81 per three leaves) followed by Spinetoram 10%+ Sulfoxaflor 40%WG @ 120 g.a.i/ha and Sulfoxaflor 24%SC @ 108 g.a.i/ha, Sulfoxaflor 24%SC @ 90 g.a.i/ha, were the next best treatments and recorded 2.02, 2.49 and 2.54 leaf hoppers per three leaves, respectively and were on par with each other. Similar trend was noticed in second and third spray (table 1).

Thrips: Thrips population a day before spray during the first treatment imposition ranged from 8.93 to 9.97 per three leaves and there was no significant difference among different treatments. Lowest population of thrips after seven days of spray was noticed in Spinetoram 10%+ Sulfoxaflor 40%WG @ 140 g.a.i/ha (2.01 per three leaves) and found superior and was on par with its lower dosage treatment. Chemical treatments Spinetoram 12%SC @ 36 g.ai/ha and Spinetoram 12%SC @ 30 g.ai/ha recorded 2.32 and 2.80 thrips per three leaves, respectively and were on par with each other. Similar trend was observed in second and third spray (table 2).

Bollworms: The population of bollworm a day before spray ranged from 2.01 to 2.95 per plant in *H. armigera* and there was no significant difference among different treatments. Seven days after spray lowest population of *H. armigera* (0.39 larva/plant) and lowest pink boll worm at harvest (2.27 larvae/ 10 bolls) was observed in Spinetoram 10%+ Sulfoxaflor 40%WG @ 140 g.a.i/ha and was on par with next lower dosage treatment of Spinetoram 10%+ Sulfoxaflor 40%WG @ 120 g.ai/ha (table 3).

Table 1: Efficacy of different novel insecticides against leafhoppers on cotton during 2017-18

Does (g.a.i.) / ha	Av. Population of pest at different crop stage														% reduction of pest over control
	First spray				Second spray				Third spray				Mean		
	1 DBS		7 DAS		1 DBS		7 DAS		1 DBS		7 DAS		1 DBS	7 DAS	
	OV	TV	OV	TV	OV	TV	OV	TV	OV	TV	OV	TV			
120	12.13	3.55	2.02	1.56	7.33	2.79	1.97	1.57	10.27	3.28	2.34	1.65	9.91	2.11	82.12
140	13.90	3.79	1.83	1.50	6.73	2.68	1.78	1.48	10.26	3.28	1.82	1.50	10.30	1.81	84.67
30	12.55	3.59	5.50	2.44	7.48	2.82	5.45	2.42	9.75	3.20	5.49	2.42	9.92	5.48	53.57
90	13.35	3.72	2.54	1.72	7.09	2.75	2.44	1.70	10.49	3.31	2.48	1.71	10.31	2.47	79.08
36	12.85	3.63	5.44	2.44	6.78	2.69	5.39	2.43	9.99	3.24	5.43	2.43	9.87	5.42	54.08
108	11.45	3.46	2.49	1.71	7.08	2.74	2.37	1.68	10.28	3.28	2.41	1.63	9.60	2.62	77.79
37.5+112.5	11.84	3.51	2.74	1.78	7.27	2.78	2.02	1.59	10.35	3.29	2.06	1.58	9.82	2.27	80.75
37.5	12.99	3.67	3.09	1.88	6.89	2.72	2.49	1.65	10.31	3.29	2.53	1.72	10.06	2.52	78.65
112.5	11.47	3.46	2.66	1.76	7.34	2.79	2.61	1.76	10.28	3.28	2.65	1.76	9.70	2.64	77.64
--	12.67	3.63	13.57	3.74	7.08	2.72	9.57	3.17	10.53	3.32	12.25	3.57	10.09	11.80	--
--	12.43	3.59	13.34	3.72	7.17	2.77	10.38	3.30	10.52	3.32	9.33	3.12	10.04	11.02	--
F Test	NS		S		NS		S		S		S				
SEd	0.18		0.20		0.14		0.25		0.13		0.27				
CD (P = 0.05)	0.52		0.42		0.40		0.71		0.38		0.57				
CV %	6.16		11.05		6.21		14.80		6.54		16.02				

O.V. – Original Value; T.V. –Transformed Value

*- Square root transformed values; DBS – Day before spray; DAS – Days after spray

Table 2: Efficacy of different novel insecticides against thrips on cotton during 2017-18

Does (g.a.i.)/ ha	Av. Population of pest at different crop stage*												Mean		% reduction of pest over control
	First spray				Second spray				Third spray						
	1 DBS		7 DAS		1 DBS		7 DAS		1 DBS		7 DAS		1 DBS	7 DAS	
	OV	TV	OV	TV	OV	TV	OV	TV	OV	TV	OV	TV			
120	9.97	3.23	2.24	1.64	9.06	3.09	2.23	1.63	6.45	2.64	2.13	1.60	8.49	2.20	78.74
140	9.13	3.10	2.04	1.57	8.88	3.06	2.05	1.58	6.49	2.64	1.95	1.57	8.17	2.01	80.53
30	9.93	3.23	2.80	1.80	8.60	3.01	2.46	1.70	6.54	2.65	2.55	1.73	8.36	2.44	76.37
90	9.03	3.09	3.77	2.06	8.51	3.00	4.07	2.13	7.00	2.74	3.97	2.11	8.18	3.94	61.91
36	9.63	3.18	2.32	1.66	8.57	3.01	2.33	1.66	5.85	2.52	2.23	1.63	8.02	2.52	75.61
108	8.97	3.08	2.70	1.77	8.87	3.06	3.03	1.87	6.48	2.64	2.93	1.85	8.11	2.89	72.06
37.5+112.5	9.00	3.08	4.15	2.15	9.13	3.10	2.82	1.81	7.07	2.75	2.71	1.77	8.40	3.23	68.78
37.5	9.27	3.12	2.88	1.82	9.12	3.10	3.23	1.92	7.06	2.75	3.12	1.89	8.48	3.08	70.25
112.5	9.17	3.11	2.80	1.80	8.68	3.03	3.13	1.89	5.96	2.54	2.70	1.75	7.94	2.88	72.17
--	8.93	3.07	9.34	3.13	9.20	3.11	10.87	3.36	6.90	2.72	10.80	3.35	8.35	10.34	--
--	9.30	3.13	11.21	3.41	9.34	3.14	11.13	3.40	6.48	2.64	11.03	3.39	8.37	11.12	--
F Test	NS		S		S		S		S		S				
SEd	0.08		0.18		0.03		0.19		0.07		0.17				
CD (P = .05)	0.17		0.39		0.07		0.40		0.16		0.37				
CV %	13.23		11.08		7.35		11.38		13.67		10.66				

O.V. – Original Value; T.V. –Transformed Value

*- Square root transformed values; DBS – Day before spray; DAS – Days after spray

Table 3: Efficacy of different novel insecticides against bollworms and yield of cotton during 2017-18

T. No.	Chemical	Does (g.a.i.)/ ha	*H. armigera* (larvae/plant)		*P. gossypiella* (larvae/10 bolls) at 120 DAS	Yield (q/ha)
			1DBS	7DAS		
1	Spinetoram + Sulfoxaflor 40 %WG	120	2.95	0.50 (1.00)	2.39 (1.70)	13.72 (3.76)
2	Spinetoram + Sulfoxaflor 40 %WG	140	2.01	0.39 (0.94)	2.27 (1.66)	14.27 (3.83)
3	Spinetoram 12%SC	30	2.14	0.72 (1.10)	2.61 (1.76)	12.00 (3.53)
4	Sulfoxaflor 24%SC	90	2.01	2.13 (1.62)	4.02 (2.13)	8.04 (2.89)
5	Spinetoram 12%SC	36	2.15	0.52 (1.01)	2.54 (1.74)	11.79 (3.50)
6	Sulfoxaflor 24%SC	108	2.12	1.89 (1.55)	3.78 (2.07)	10.71 (3.33)
7	Pyriproxyfen 5% + Fenpropathrin 15% EC	37.5+112.5	2.24	1.42 (1.39)	3.31 (1.95)	9.10 (3.07)
8	Pyriproxyfen 5% EC	37.5	2.35	1.79 (1.51)	3.68 (2.04)	8.84 (3.03)
9	Fenpropathrin 15% EC	112.5	2.18	1.73 (1.49)	3.62 (2.03)	8.55 (3.01)
10	Control (Unsprayed)	--	2.04	2.72 (1.79)	8.70 (3.03)	3.90 (2.09)
11	Control (water spray)	--	2.25	2.80 (1.82)	8.50 (3.00)	4.07 (2.12)
F test			NS	S	S	S
Sed			0.36	0.01	0.02	0.12
CD @ 0.05			0.12	0.05	0.05	0.35
CV			6.34	5.65	8.34	8.72

DBS: Day before spray DAS: Day after spray

Figures in parentheses are square root transformed values

Seed Cotton Yield

Overall seed cotton yield was low because of severe pink bollworm incidence. The maximum seed cotton yield of 14.27 q/ha was recorded in the treatment Spinetoram 10% + Sulfoxaflor 40%WG @ 140 g.ai/ha followed by Spinetoram 10% + Sulfoxaflor 40%WG @ 120 g.ai/ha (13.72 q/ha) and both the treatments were on par with each other. Lowest yield was noticed in the untreated control without spray and untreated control with water spray.

Discussion

In the management of cotton leafhoppers superiority of Spinetoram 10%+ Sulfoxaflor 40%WG is because of their combined action where Spinetoram being xylem mobile insecticide affects nicotinic acetylcholine receptors and γ-amino butyric acid (GABA) receptors existing on postsynaptic membranes in insect nervous systems, thereby causing abnormal neural transmission and Sulfoxaflor acts as an agonist at insect nicotinic acetylcholine receptors. Moreover Sulfoxaflor is part of chemical class of insecticides known as the sulfoximines, a group that has not previously been associated with crop protection chemistries thus offers efficient control of the pest. These finding were in agreement with [2] who also reported low leafhopper population with Spinetoram 10%+ Sulfoxaflor 40%WG @ 140 g.a.i/ha treatment.

In the management of thrips Spinetoram 10%+ Sulfoxaflor 40%WG @ 140 g.a.i/ha found effective. These finding were in agreement with [4] who reported that Spinetoram applied at 13.0 to 26.0 g a.i./ha provided better control comparable to commercial standards under moderate infestation levels. Where as in our study Spinetoram 10%+ Sulfoxaflor 40%WG is superior because of their combined and novel mode of action as explained earlier.

Conclusion

Overall in the management of leafhoppers, thrips and bollworms Spinetoram 10%+ Sulfoxaflor 40%WG at 140 g a.i./ha is superior over other treatments.

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