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Evaluation of scheduled sequential sprays of newer insecticides against pink bollworm *Pectinophora gossypiella* (Saunders) in cotton

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Abstract
A field trial was conducted to evaluate the scheduled sequential sprays of new insecticide molecules against pink bollworm *Pectinophora gossypiella* (Saunders) in cotton during 2018 to 2020 at Regional Agricultural research station, Nandyal. Mean of two years data revealed that erection of pheromone traps at 45 DAS and spray of Neem oil 1500 ppm@ 5 ml/liter of water, Chlorantraniliprole 18.5SC @ 0.3ml/liter of water followed by spray of Bifenthrin 10% EC @ 1ml/liter of water at weekly intervals after pink bollworm crossing ETL had recorded lowest green boll damage, open boll damage and lowest pink bollworm larvae per twenty green bolls with highest yield.

Keywords: Pink bollworm, new insecticide molecules, green boll damage, Pheromone traps, Chlorantraniliprole 18.5SC

Introduction
Cotton *Gossypium hirsutum* L. (Family: Malvaceae) is the major commercial crop cultivated in India across all the zones north, south and central, cotton is famously called as white gold due to its higher premium in international markets. Majority of the cotton acreage i.e. nearly 95% area is covered with transgenic bollgard-II cotton, although bollgard-II cotton performed satisfactorily during the initial years of introduction, recently since last 7-8 years Bt cotton is becoming vulnerable to pink bollworm which has become the major threat to cotton cultivation. The pest spectrum of cotton crop is quite complex comprising of several species of the insects. Bollworm complex *viz*., American bollworm (*Helicoverpa armigera* Hub.), spotted bollworm (*Earias vitella* Fab.) and pink bollworm (*Pectinophora gossypiella* Saunders) account for a considerable yield loss to the extent of 36.2 per cent losses by the bollworm complex [1]. The Pink bollworm has developed resistance to majority of the commercially available Bt cotton hybrids in India. Management strategies aimed at containing pink bollworm often becomes difficult due to its concealed feeding nature and less time spend outside the boll, hence cultivation of Bt cotton alone is not a panacea for pink bollworm management, Bt cotton cultivation along with sound management tactics with ecologically sound bio rational and safer insecticides will manage the pink bollworm in cotton. Farmers are often confused with insecticidal sequence and timing of application to be followed in managing pink bollworm and resorting to indiscriminate spray of cocktail mixtures which not only increases cultivation costs but also harm the crop growth. Monitoring of pink bollworm with pheromone traps forms the basis for estimating Economic threshold levels also, further old generation synthetic pyrethroids and organophosphates like Profenophos, Thiodicarb and Fenvalrate are becoming obsolete and new generation molecules like Chlorantraniliprole 18.5SC and Bifenthrin 10% EC need to be tested for their effectiveness. Efficacy of new molecules like Spinosad and Indoxacarb 15 SC against boll worm were noticed [2]. Indiscriminate use of organophosphates, Carbamates and Synthetic pyrethroids has created a number of problems such as pests developing resistance to insecticides [3]. New molecule Emamectin benzoate 5 SG @ 11g a.i ha-1 was effective in reducing the incidence of bollworm complex and increased the cotton yield [4]. Novel molecules are also relatively safer to natural enemies like coccinellids [5]. Hence the present study was aimed at managing pink bollworm with the combination of Pheromone traps and biorationals along with new molecules used in tandem.

Materials and Methods

A Field trial was conducted to evaluate the efficacy of some of the novel molecules and old generation molecules along with pheromone traps and biorationals like neem oil used in sequence in managing pink bollworm in cotton crop. The experiment was laid out in Randomized block design with ten treatments replicated thrice at Regional Research station, Nandyal during the kharif seasons of 2018 and 2019. Jadoo B.G II cotton was sown during last week of July in both the years, spacing of 90x45cm was adopted between rows and plants respectively. Treatment size was 5x4 meters all the standard agronomic practices were adopted as prescribed by Agricultural University except plant protection practices for boll worms. A total of ten treatments were used in the experiment with a combination of old and new molecules, treatmental imposition of all the treatments were done after pink bollworm crossing economic threshold level i.e. at 90 DAS. Economic threshold levels were monitored with the help of pheromone trap catches i.e. 10 moths/trap/day for three consecutive days and also with the destructive sampling of twenty green bolls where in two green bolls containing live larvae i.e. 10 percent of damage is regarded as economic threshold level for pink bollworm in cotton. Pheromone traps were erected in three treatments i.e. T5, T6, and T7 at 45 DAS which were followed by spray with different insecticides of old and new chemistries after pink bollworm crossed ETL. In all the treatments sequence of insecticides were used at weekly interval so as to evaluate which sequence is effective in managing pink bollworm, a total of two sprays were imposed second spray was imposed at an interval of fifteen days after first spray i.e. 120 DAS. Green boll damage, open boll damage and number of pink bollworm larvae per twenty green bolls were recorded at 110, 140 and 150 DAS and open boll damage was recorded at the time of harvest. Yield in Kg/ha was recorded in each treatment and converted into per hectare yield. Green boll damage, open boll damage, pink bollworm larvae per twenty green bolls and yield were depicted in tables 1-6.

Results

During the year 2018-19: Green boll damage and open boll damage were recorded at 110,140 and 150 DAS, results of insecticidal sequence sprays during the year 2018-19 indicates that among different insecticidal sequences used, the sequence of pheromone traps erected at 45 DAS followed by spray of neem oil 1500 ppm @ 5ml/liter of water and Chlorantraniliprole 18.5SC @ 0.3 ml/liter of water and Bifenthrin 10% EC @ 1ml/liter of water sprayed at weekly intervals after pink bollworm crossed ETL i.e 90 DAS had recorded lowest green boll damage open boll damage and pink bollworm larvae per twenty green bolls which was on par with sprays pheromone traps along with sprays of Profenophos and Phenthoate followed by pheromone traps along with sprays of neem oil, Thiodicarb and Cypermethrin ,followed by spray with Profenophos followed by Thiodicarb and Chloropyriphos followed by Bifenthrin which recorded 26.87, 28.00, 30.67, 32.0 36.00 and 36.00% of green boll damage by boll basis by pink bollworm, respectively. However, the highest green boll damage by pink bollworm on boll basis was recorded in sprays of Thiodicarb alone at weekly intervals i.e. 44.00% at 110 DAS. At 140 DAS the lowest green boll damage of 41.33% was recorded in sprays with pheromone traps along with sprays of neem oil, Chlorantraniliprole followed by Bifenthrin, at weekly intervals which was on par with sprays of Chloropyriphos alone at weekly intervals and Chlorantraniliprole followed by Chloropyriphos and pheromone traps along with neem oil, Thiodicarb and Cypermethrin and Chloropyriphos followed by Bifenthrin and Phenthoate alone at weekly intervals which recorded 49.83, 49.33, 50.67, 52.0 and 58.67% green boll damage by pink bollworm on boll basis, respectively. At 150 DAS Pheromone traps along with sprays of neem oil , Chlorantraniliprole followed by Bifenthrin recorded the lowest green boll damage of 26.67% by pink bollworm on boll basis which was on par with sprays of Profenophos followed by Phenthoate at weekly intervals. The mean lowest green boll damage on boll basis by pink bollworm was recorded in pheromone traps along with sprays of Neem oil , Chlorantraniliprole followed by Bifenthrin i.e. 33.56% followed by sprays of Chloropyriphos followed by Bifenthrin at weekly intervals which recorded 38.22% green boll damage, by pink boll worm**.**

Open boll damage by PBW at harvest (locule basis)

The lowest open boll damage on locule basis i.e. 10.66% was recorded in pheromone traps along with sprays of neem oil, Chlorantraniliprole followed by Bifenthrin which was on par with sprays of phenthoate alone at weekly intervals followed by sprays of pheromone traps, neem oil, Thiodicarb and Cypermethrin at weekly intervals, which recorded 15.65, and 17.01, open boll damage on locule basis respectively.

No. of pink bollworm larvae/ 20 green bolls

The mean of pink bollworm larvae per 20 green bolls after 110,140 and 150 days reveals that treatment pheromone traps along with sprays of neem oil, Chlorantraniliprole followed by Bifenthrin has recorded lowest larvae of 6.67/20 green bolls.

Yield

Highest yield of 2660 kg/ha was recorded in pheromone traps along with sprays of neem oil, Chlorantraniliprole followed by Bifenthrin which is on par with sprays of Chloropyriphos followed by Bifenthrin which recorded yield of 2136kg/ha.

During the year 2019-20 no significant difference among the treatments were noticed at 110 DAS, at 140 and 150 DAS same trend was observed as that of previous year. At 140 DAS, the lowest green boll damage of 6.67% was recorded in sprays with pheromone traps along with sprays of neem oil, Chlorantraniliprole followed by Bifenthrin, at weekly intervals which was on par with sprays of Profenophos followed by Thiodicarb and Phenthoate alone at weekly intervals which recorded 9.33 and 9.33% green boll damage by pink bollworm on boll basis, respectively. At 150 DAS Pheromone traps along with sprays of neem oil, Chlorantraniliprole followed by Bifenthrin recorded the lowest green boll damage of 33.3% which was on par with sprays of Profenophos followed by Thodicarb, Chlorantraniliprole followed by Chloropyriphos, Chloropyriphos followed by Bifenthrin, Phenhoate alone at weekly intervals and pheromone traps along with neem oil, Thiodicarb and Cypermethrin at weekly intervals which recorded 33.53, 36.0, 40.0, 37.33 and 37.33% green boll damage by pink bollworm respectively.

The mean lowest green boll damage on boll basis by pink bollworm was recorded in pheromone traps along with sprays of neem oil, Chlorantraniliprole followed by Bifenthrin i.e. 15.56% followed by sprays of Chlorantraniliprole and

Chloropyriphos followed by Phenthoate alone at weekly intervals which recorded 17.78 and 17.33% green boll damage, by pink bollworm respectively**.**

Open boll damage by PBW at harvest (locule basis)

The lowest open boll damage on locule basis i.e15.70% was recorded in pheromone traps along with sprays of neem oil, Chlorantraniliprole followed by Bifenthrin which was on par with sprays of Phenthoate alone at weekly intervals followed by sprays of pheromone traps, neem oil, Thiodicarb and Cypermethrin, Chlorantraniliprole followed by Chloropyriphos, and Profenophos followed by Thodicarb at weekly intervals, which recorded 19.17, 21.30, 16.70 and 16.19% open boll damage on locule basis, respectively.

No. of pink bollworm larvae/ 20 green bolls

No significant difference among treatments was noticed with regard to No of pink bollworm larvae in 20 green bolls at 110 DAS

At 140 DAS lowest pink bollworm larvae per 25 green bolls was recorded in treatment pheromone traps along with sprays of neem oil, Chlorantraniliprole followed by Bifenthrin i.e. 1.33/20 green bolls which was at par with majority of the entries except Chloropyriphos followed by Bifenthrin, Thiodicarb alone at weekly intervals and Chloropyriphos at weekly intervals which recorded highest larval population of 4.33, 5.67 and 3.33 pink bollworm larvae per 25 green bolls respectively.

At 150 DAS lowest pink bollworm larvae per 20 green bolls was recorded in treatment pheromone traps along with sprays neem oil, Chlorantraniliprole followed by Bifenthrin i.e. 5.67/20 green bolls which was at par with Profenophos followed by Thiodicarb, Chlorantraniliprole followed by Chloropyriphos and Phenthoate alone at weekly intervals which recorded 6.67, 7.33, and 8.33 pink bollworm larvae per 20 green bolls respectively.

The mean of pink bollworm larvae per 20 green bolls after 110,140 and 150 days reveals that treatment pheromone traps along with sprays of neem oil, Chlorantraniliprole followed by Bifenthrin had recorded the lowest larvae of 2.78/20 green bolls.

Yield

Highest yield of 2635 kg/ha was recorded in pheromone traps along with sprays of neem oil, Chlorantraniliprole followed by Bifenthrin which is on par with sprays of Chlorantriniliprol followed by Chloropyriphos and Profenophos followed by Thodicarb which recorded a yield of 2457 kg/ha and 2237 kg/ha respectively.

Discussion

The above results indicate that the correct insecticidal sequence with right time of application i.e. at ETL with new chemistries manages the pink bollworm effectively. As the old chemistries are going to be phased out in due course also they are hazardous to environment and mankind, it is high time to evaluate the novel molecules against pink bollworm. Reports of high level of resistance to the conventional insecticides in *Helicoverpa armigera* and other pests of cotton [6] have resulted in renewed interest in the farmers for using new group of insecticides available in the market. The present results are in corroboration with the findings which proved that Chlorantraniliprole 18.5% SC recorded minimum per cent fruiting body damage [7]. From the foregoing results it clearly indicates that the sequence of neem oil spray after pink bollworm crosses ETL acts as ovi deterrent and also repels the adult female in laying eggs this is followed by a new chemistry Chlorantriniliprole which is novel in its mode of action opens muscular calcium channels in particular the ryanodine receptor rapidly causing paralysis and ultimately death of sensitive species. The differential selectivity Chlorantraniliprole had towards insect ryanodine receptors explained the outstanding profile of low mammalian toxicity followed by Bifenthrin which is also new generation i.e fourth generation synthetic pyrethroid because they are more effective against insects at lower dosages than the third-generation pyrethroids, these contemporary pyrethroids are generally applied at much lower rates typically 10% of the third-generation rates. The fourth-generation pyrethroids are photostable and relatively nonvolatile, so their residual activity is longer than that of earlier pyrethroids. The above sequence is supplemented with pheromone traps which help in proper monitoring of pink boll worm Economic threshold level. New chemical group of insecticides has novel mode of action to offset the resistance problem [8]. Thus Neem oil 1500 ppm@ 5ml/lit of water, Chlorantraniliprole 18.5SC@ 0.3ml/lit of water and Bifenthrin 10%EC@ 1ml/lit of water used in sequence can effectively pink bollworm in cotton with higher yields.

Conclusion

Erection of pheromone traps@ 45 DAS followed by sequential spray of Neem oil 1500ppm@5ml/lit of water followed by Chlorantraniliprole 18.5SC@ 0.3ml/lit of water and Bifenthrin 10%EC @ 1ml/lit of water at weekly intervals after the pest crossed ETL effectively controls pink bollworm in cotton.

Table 1: Efficacy of different scheduled spray of insecticides on green boll damage and open boll damage in cotton during 2018-19

Treatments	Time	Green boll damage(per 20 bolls)			Mean	Open boll damage at harvest (%)
		110DAS	140DAs	150DAS		
Profenophos followed by phenthoate	At ETL	37.33	82.67	42.33	54.11	21.37
		(37.64)**	(65.57)**	(40.54)**		(27.44)**
Chlorpyriphos followed by bifenthrin	At ETL	36.00	52.00	56.00	38.22	14.07
		(36.87)	(46.18)	(48.54)		(21.98)
Profenophos followed by Thiodicarb	At ETL	32.00	66.67	51.33	50.00	31.89
		(34.38)	(54.98)	(45.80)		(34.39)
Chlorantraniliprole followed by chlorpyriphos	At ETL	26.67	49.33	56.00	44.0	20.44
		(31.00)	(44.71)	(48.54)		26.71
Pheromone traps+Neem oil-Profenophos - phenthoate	At 45 DAS+ETL	28.00	61.33	53.33	47.56	18.42
		(31.93)	(51.63)	(46.95)		(25.38)
Pheromone traps+Neem oil-Thiodicarb -cypermethrin	At 45 DAS+ETL	30.67	50.67	44.67	42.00	17.01
		(33.52)	(45.41)	(41.95)		(24.20)

Pheromone traps+Neemoil-Chlorantraniliprole - bifenthrin	At 45 DAS+ETL	26.87	41.33	26.67	33.56	10.66
		(31.04)	(40.01)	(31.01)		(19.03)
Phenthoate alone at weekly intervals	At ETL	37.33	58.67	43.00	46.33	15.65
		(37.64)	(50.07)	(40.95)		(23.25)
Thiodicarb alone at weekly intervals	At ETL	44.00	70.67	66.33	50.56	20.42
		(41.54)	57.31	(54.85)		(26.72)
Chloryriphos alone at weekly intervals	At ETL	36.00	49.83	72.67	59.78	28.49
		(36.87)	(44.78)	(58.62)		(32.19)
F-Test		S	S	S		S
Sed		2.93	4.87	4.61		2.54
CD(P=0.05)		6.17	10.24	9.69		5.35
CV(%)		10.24	11.95	12.82		11.94

**Figures in parentheses are arc-sin transformed values

Table 2: Efficacy of different scheduled spray of insecticides against pink bollworm larvae and yield of cotton during 2018-19

Treatments	Time	No. of pink bollworm larvae(20 bolls)				Seed cotton Yield (kg/ha)
		110DAS	140Das	150DAS	Mean	
Profenophos followed by phenthoate	At ETL	6.33	9.00	6.33	7.22	1991.77
		(2.61)	(3.08)	(2.60)		
Chlorpyriphos followed by bifenthrin	At ETL	7.00	13.00	6.11	8.44	2136.63
		(2.72)	(3.66)	(2.12)		
Profenophos followed by Thiodicarb	At ETL	4.33	8.67	6.00	6.33	1715.23
		(2.18)	(3.02)	(2.52)		
Chlorantraniliprole followed by chlorpyriphos	At ETL	3.33	10.67	9.00	7.67	1708.64
		(1.95)	(3.34)	(3.07)		
Pheromone traps+Neem oil -Profenophos - phenthoate	At 45 DAS+ETL	5.33	11.00	10.67	9.00	1753.09
		(2.40)	(3.38)	(3.34)		
Pheromone traps+Neemoil -Thiodicarb -cypermethrin	At 45 DAS+ETL	4.67	7.67	11.00	7.78	1981.89
		(2.26)	(2.84)	(3.38)		
Pheromone traps+Nem oil -Chlorantraniliprole - bifenthrin	At 45 DAS+ETL	4.50	7.33	5.33	6.67	2660.08
		(2.21)	(2.79)	(2.39)		
Phenthoate alone at weekly intervals	At ETL	5.33	12.00	6.67	8.00	1960.49
		(2.41)	(3.53)	(2.66)		
Thiodicarb alone at weekly intervals	At ETL	8.33	10.00	7.33	8.56	1481.48
		(2.96)	(3.22)	(2.78)		
Chloryriphos alone at weekly intervals	At ETL	5.33	11.00	8.00	7.22	1458.44
		(2.40)	(3.39)	(2.90)		
F-Test		S	S	S		S
Sed		0.22	0.24	0.28		272.50
CD(P=0.05)		0.47	0.51	0.59		572.50
CV(%)		11.28	9.26	12.09		17.71

*Figures in parentheses are square root (x+0.5) transformed values

Table 3: Efficacy of different scheduled spray of insecticides on green boll damage and open boll damage in cotton during 2019-20

Treatments	Time	Green boll damage (per 20 bolls)			Mean	Open boll damage at harvest (%)
		110DAS	140DAS	150DAS		
Profenophos followed by phenthoate	At ETL	8.00	18.67	46.67	24.44	31.73
		(16.09)**	(25.58)**	(43.10)**		(34.25) **
Chlorpyriphos followed by bifenthrin	At ETL	8.00	13.33	40.00	20.44	25.96
		(16.09)	(21.38)	(39.24)		(30.61)
Profenophos followed by Thiodicarb	At ETL	8.00	9.33	33.53	16.89	16.19
		(16.09)	(17.72)	(35.36)		(23.52)
Chlorantraniliprole followed by chlorpyriphos	At ETL	6.67	10.67	36.00	17.78	16.70
		(14.45)	(18.82)	(36.70)		(24.03)
Pheromone traps+Neem oil-Profenophos - phenthoate	At 45 DAS+ETL	6.67	14.67	46.67	22.67	23.24
		(14.81)	(22.38)	(43.10)		(28.77)
Pheromone traps+Neem oil-Thiodicarb -cypermethrin	At 45 DAS+ETL	5.33	13.33	37.33	18.67	21.30
		(13.17)	(21.38)	(37.68)		(27.48)
Pheromone traps+Neem oil-Chlorantraniliprole- bifenthrin	At 45 DAS+ETL	6.67	6.67	33.33	15.56	15.70
		(14.45)	(14.81)	(35.23)		(23.34)
Phenthoate alone at weekly intervals	At ETL	5.33	9.33	37.33	17.33	19.17
		(13.17)	(17.72)	(37.60)		(25.87)
Thiodicarb alone at weekly intervals	At ETL	6.67	12.00	48.00	22.22	28.08
		(14.45)	(20.10)	(43.87)		(31.98)
Chloryriphos alone at weekly intervals	At ETL	13.33	16.00	53.33	27.56	33.03
		(21.21)	(23.59)	(46.95)		(35.04)

F-Test	NS	S	S		S
Sed	3.4	2.10	3.63		2.48
CD(P=0.05)	NS	4.42	7.63		5.23
CV(%)	27.10	12.67	11.15		10.70

**Figures in parentheses are arc-sin transformed values

Table 4: Efficacy of different scheduled spray of insecticides against pink bollworm larvae and yield of cotton during 2019-20.

Treatments	Time	No.of pink bollworm larvae(20 bolls)				Seed cotton Yield (kg/ha)
		90DAS	110DAS	130DAS	Mean	
Profenophos followed by phenthoate	At ETL	1.33	2.33	11.00	4.89	1975
		(1.34)	(1.34) *	(1.68) *		
Chlorpyriphos followed by bifenthrin	At ETL	2.00	4.33	12.33	6.22	2137
		(1.56)	(1.56)	(2.18)		
Profenophos followed by Thiodicarb	At ETL	2.00	1.67	6.67	3.44	2237
		(1.56)	(1.56)	(1.44)		
Chlorantraniliprole followed by chlorpyriphos	At ETL	1.33	1.67	7.33	3.44	2457
		(1.34)	(1.34)	(1.46)		
Pheromone traps+Neem oil-Profenophos -phenthoate	At 45 DAS+ ETL	1.67	2.67	9.33	4.56	1956
		(1.46)	(1.46)	(1.76)		
Pheromone traps+Neem oil-Thiodicarb -cypermethrin	At 45 DAS+ ETL	1.33	2.33	10.00	4.56	1716
		(1.34)	(1.34)	(1.68)		
Pheromone traps+neem oil-Chlorantraniliprole - bifenthrin	At 45 DAS+ETL	1.33	1.33	5.67	2.78	2635
		(1.34)	(1.34)	(1.34)		
Phenthoate alone at weekly intervals	At ETL	2.00	1.67	8.33	4.00	2189
		(1.56)	(1.56)	(1.46)		
Thiodicarb alone at weekly intervals	At ETL	1.33	5.67	9.67	5.56	1235
		(1.34)	(1.34)	(2.47)		
Chloryriphos alone at weekly intervals	At ETL	1.33	3.33	13.67	6.11	1029
		(1.34)	(1.34)	(1.94)		
		(1.46)	(1.46)	(3.39)		
F-Test		NS	S	S		S
Sed		0.20	0.21	0.28		212.90
CD(P=0.05)		NS	0.45	0.59		447.29
CV(%)		17.6	15.03	11.12		13.26

*Figures in parentheses are square root (x+0.5) transformed values

Table 5: Efficacy of different scheduled sequential spray of insecticides on mean green and open boll damage in cotton

Treatment	Green boll damage in percentage		Mean	Open boll damage in percentage		Mean
	2018-19	2019-20		2018-19	2019-20	
Profenophos followed by phenthoate	54.11	24.44	39.2	21.37	31.73	26.55
Chlorpyriphos followed by bifenthrin	38.22	20.44	29.33	14.07	25.96	20.00
Profenophos followed by Thiodicarb	50.00	16.89	33.44	31.89	16.19	24.04
Chlorantraniliprole followed by chlorpyriphos	44.0	17.78	30.89	20.44	16.70	18.57
Pheromone traps+Neem oil -Profenophos followed by phenthoate	47.56	22.67	35.11	18.42	23.24	20.83
Pheromone traps+Neem oil-Thiodicarb followed by cypermethrin	42.00	18.67	30.33	17.01	21.30	19.02
Pheromone traps+Neem oil-Chlorantraniliprole followed by bifenthrin	33.56	15.56	24.56	10.66	15.70	13.18
Phenthoate alone at weekly intervals	46.33	17.33	31.83	15.65	19.17	17.41
Thiodicarb alone at weekly intervals	50.56	22.22	36.39	20.42	28.08	24.25
Chloryriphos alone at weekly intervals	59.78	27.56	43.67	28.49	33.03	30.76

Table 6: Efficacy of different scheduled sequential sprays of insecticides on mean pink bollworm larvae per 20 green bolls in cotton

Treatment	Pink bollworm larvae per 20 green bolls		Mean
	2018-19	2019-20	
Profenophos followed by phenthoate	7.22	4.89	6.0
Chlorpyriphos followed by bifenthrin	8.44	6.22	7.3
Profenophos followed by Thiodicarb	6.33	3.44	4.8
Chlorantraniliprole followed by chlorpyriphos	7.67	3.44	5.5
Pheromone traps+Neem oil -Profenophos followed by phenthoate	9.00	4.56	6.7
Pheromone traps+Neem oil-Thiodicarb followed by cypermethrin	7.78	4.56	6.1
Pheromone traps+Neem oil-Chlorantraniliprole followed by bifenthrin	6.67	2.78	4.7
Phenthoate alone at weekly intervals	8.00	4.00	6.0
Thiodicarb alone at weekly intervals	8.56	5.56	7.0
Chloryriphos alone at weekly intervals	7.22	6.11	6.6

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