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BIO-EFFICACY OF VOLIAM FLEXI 300 W/V SC (CHLORANTRANILIPROLE 8.8% W/W + THIAMETHOXAM 17.5% W/W) AGAINST PESTS COMPLEX IN OKRA

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ABSTRACT

A field experiment was carried out at Rajasthan College of Agriculture, MPUAT, Udaipur during the two consecutive years 2017 and 2018 in a randomized block design with eight treatments and three replications. Okra variety JKOH-7315 was sown in the plot size of 5.0 m x 3.15m with plant spacing of 50 cm X 35 cm. The results revealed that all treatments were significantly superior over control. Among the treatments Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 600 ml/ha were found most effective treatments against all the major insect pests of okra. No significant difference was observed in natural enemies' population in treated plots as compared to the control. Therefore Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w can be fit in IPM programme.

Keywords: Okra, bioefficacy, voliam flexi, insect-pest

INTRODUCTION

Okra, *Abelmoschus esculentus* (L), is a malvaceous vegetable which is cultivated throughout the world. It is one of the important and commercially cultivated vegetable crops, which is popularly called as Bhindi or Lady's finger. It can tolerate poor soils with heavy clay and intermittent moisture owing to its drought tolerant characters. It is grown in an area of 532.7 thousand ha with production of 6346.4 thousand MT (Anonymous, 2014). The fruits are rich in dietary fiber and protein. Insect pests are one of the important limiting factors in the cultivation of okra. Shoot and fruit borers *viz*., *Earias vitella*, *Earias insulana* and *Helicoverpa armigera*, the sucking pests like leafhopper (*Amrasca biguttula*), aphid (*Aphis gossypii*), whitefly (*Bemisia tabaci*) are known to cause severe damage to the crop. Sucking pests infest this crop and devitalize the plants from seedling to harvest stage, and cause yield loss. Failure to control pest problem in the initial stages may cause yield loss to a large extent. The important insect pests during early stage of crop growth are leaf hoppers (*Amrasca bigutulla*), aphids (*Aphis gossypii* Glover), and white fly (*Bemisia tabaci* Genn.) while at later stage fruit borers like *Earias* spp. and *Helicoverpa armigera* (Hb.) cause considerable losses to the crop to the tune of 91.6 per cent (Shah *et al*., 2001). Of the various pests infesting okra, fruit borers (*Earias* spp. and *Helicoverpa armigera* (Hubner), leaf hopper, aphid and red spider mite are more devastating, which reduce the yield and vitality of the plant (Sivakumar *et al*., 2003) Kamble *et al.* (2014) reported shoot and fruit borer infestation on okra as 32.14 per cent on number basis and 31.31 per cent on weight basis. Being a high valued crop, chemical control is largely practiced for the pest control. Though pesticides like endosulfan, synthetic pyrethroids, carbamates are effective in pest control, decreased interval between the pickings, have resulted in increased residual concentration, being harmful for consumption. Resurgence and resistance are also considerable problems. Hence the focus shifts towards eco safe insecticides with novel mode of actions, nature compatible and safe to natural enemies. Hence, the following study was carried out.

MATERIALS AND METHODS

The field experiment was laid out with okra variety JKOH-7315 at RCA farm, Udaipur during *Kharif* 2017 and 2018, in a Randomized Block Design to standardize the dose and to assess the bio efficacy and effect on natural enemies of Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w against pest of okra. The experiment was laid out in the plot size of 5.0m X 3.15m with plant spacing of 50cm X 35cm.

Treatment Details-

Tr. No.	Treatments	Dose g ai /ha	Dose Product g or ml/ha
1.	Control (Untreated check)	-	-
2.	Voliam Flexi 300 w/v SC (Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w)	120 (40+80)	400
3.	Voliam Flexi 300 w/v SC (Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w)	150 (50+100)	500
4.	Voliam Flexi 300 w/v SC (Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w)	180 (60+120)	600
5.	Chlorantraniliprole 18.5% SC	25	125
6.	Thiamethoxam 25% WG	25	100
7.	Carbofuran 3% CG	1000	33300
8.	Pyriproxyfen 5% EC + Fenpropathrin 15% EC	37.5 + 112.5	750

Observation

- Number of aphids (per three leaves) were recorded from five randomly selected plants after 14, 21, 28, 35, 42 and 49 after application during both the year of experiments.
- Number of jassids (per three leaves) were recorded from five randomly selected plants after 14, 21, 28, 35, 42 and 49 after application during both the year of experiments.
- Number of live mines caused by leaf miner (per leaf) were recorded from five randomly selected plants after 14, 21, 28, 35, 42 and 49 after application during both the year of experiments. Three leaves were observed per plant.
- The fruit damage caused by fruit borer i.e. Spotted fruit borer, *Earias* spp. was recorded on five randomly selected plants in each replication at 42 and 49 days after application by counting the total number of fruits and damaged fruits on 5 plants. Mean fruit damage percentage was calculated as below.

$$\text{Mean fruits damage (\%)} = \frac{\text{Number of damaged fruits}}{\text{Total number of fruits}} \times 100$$

The observation on the population of fruit borer, *i.e.*, *Helicoverpa armigera* was recorded on five randomly selected plants at 42 and 49 days after application.

- Population of *Coccinellid* (per 5 plants) were recorded at 20 days after application during both the year of experiments.

RESULTS AND DISCUSSION

1. Aphids (*Aphis gossypii*)

The data presented in table 1 and 2 revealed that lowest mean population of aphids was recorded in Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 600 ml/ha treated plot, which remained at par with Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 500 ml/ha and provided effective control up to 35 days after application. The next best treatments were, Thiamethoxam 25% WG @ 100g/ha and Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 400 ml/ha. Chlorantraniliprole 18.5% SC @ 125 ml/ha, Carbofuran 3% CG @ 33300 g/ha and Pyriproxyfen 5% EC + Fenpropathrin 15% EC @ 750 ml/ha were found less effective against aphids.

2. Jassids (*Amrasca devastans*)

The data presented in table 3 and 4 indicated that Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w offered moderate control of jassids up to 35 days after application. Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 600 ml/ha recorded lowest population of jassids and remained at par with Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 500 ml/ha. The next best treatments were, Thiamethoxam 25% WG @ 100g/ha and Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 400 ml/ha. Chlorantraniliprole 18.5% SC @ 125 ml/ha, Carbofuran 3% CG @ 33300 g/ha and Pyriproxyfen 5% EC + Fenpropathrin 15% EC @ 750 ml/ha were found less effective against jassids.

Table 1. Effect of Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w on aphids of okra (2017)

Tr. No.	Treatments	Number of aphids/3 leaves*					
		14 DAA	21 DAA	28 DAA	35 DAA	42 DAA	49 DAA
1	Untreated	11.33 (3.40)	14.33 (3.83)	18.00 (4.29)	20.67 (4.59)	23.33 (4.87)	27.00 (5.24)
2	Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 400 ml/ha	2.67 (1.77)	4.67 (2.27)	6.67 (2.67)	8.67 (3.02)	11.00 (3.39)	14.67 (3.89)
3	Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 500 ml/ha	1.33 (1.34)	1.67 (1.46)	3.33 (1.93)	5.33 (2.40)	7.00 (2.73)	11.00 (3.38)
4	Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 600 ml/ha	1.00 (1.22)	1.33 (1.34)	2.67 (1.77)	4.67 (2.26)	6.00 (2.54)	9.67 (3.18)
5	Chlorantraniliprole 18.5% SC @ 125 ml/ha	10.33 (3.28)	12.67 (3.62)	15.67 (4.01)	18.67 (4.36)	21.00 (4.63)	24.67 (5.01)
6	Thiamethoxam 25% WG @ 100g/ha	2.33 (1.68)	4.00 (2.11)	6.33 (2.60)	9.00 (3.08)	10.67 (3.34)	15.00 (3.92)
7	Carbofuran 3% CG @ 33300 g/ha	10.00 (3.20)	12.00 (3.52)	16.33 (4.10)	19.67 (4.49)	21.33 (4.67)	25.33 (5.08)
8	Pyriproxyfen 5% EC + Fenpropathrin 15% EC @ 750 ml/ha	9.67 (3.17)	12.67 (3.61)	17.00 (4.18)	19.00 (4.41)	21.67 (4.70)	24.00 (4.94)
	SEm ±	0.22	0.20	0.19	0.19	0.15	0.15
	CD at 5 %	0.66	0.61	0.56	0.57	0.45	0.44
	CV %	15.87	12.85	10.07	9.04	6.70	5.86

*Mean of three replications, DAA – Days After Application

Figures in parentheses are square root of √ x+ 0.5

3. Leaf miner (*Liriomyza trifolii*)

The data presented in table 5 and 6 revealed that Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w offered moderate control of leaf miner. Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 600 ml/ha found most effective treatments and remained at par with its lowe dose i.e. 500 ml/ha. The next best treatments were, Chlorantraniliprole 18.5% SC @ 125 ml/ha and Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 400 ml/ha. Thiamethoxam 25% WG @ 100g/ha, Carbofuran 3% CG @ 33300 g/ha and Pyriproxyfen 5% EC + Fenpropathrin 15% EC @ 750 ml/ha were found less effective against leaf miner of okra.

4. Fruit borers (*Earias* spp. and *Helicoverpa armigera)*

The data presented in table 7 and 8 revealed that Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 600 ml/ha found most effective treatments against fruit borers i.e. *Earias* spp. and *Helicoverpa armigera*, which remained at par with Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 500 ml/ha during both year of experiments.

5. Effect on natural enemies

During the period of study, natural enemy population observed on 20 days after application on *coccinellids*. No significant difference was observed in natural enemies' population in treated plots as compared to the control (Table 9). Hence, Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w can be fit in IPM programme.

6. Yield (q/ha)

Two rounds of spraying of Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 600 ml/ha recorded the highest yield of 122.33 and 119.33 q/ha during 2017 and 2018, respectively. Which was ot a par with Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 500 ml/ha and superior over rest of the treatments (Table 10).

Table 2. Effect of Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w on aphids of okra (2018)

Tr. No.	Treatments	Number of aphids/3 leaves*					
		14 DAA	21 DAA	28 DAA	35 DAA	42 DAA	49 DAA
1	Untreated	12.67 (3.61)	16.00 (4.05)	19.00 (4.41)	23.33 (4.88)	27.33 (5.27)	29.67 (5.48)
2	Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 400 ml/ha	3.33 (1.95)	4.33 (2.20)	6.67 (2.67)	9.67 (3.18)	13.67 (3.75)	17.00 (4.18)
3	Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 500 ml/ha	1.67 (1.46)	2.33 (1.68)	3.67 (2.04)	6.33 (2.60)	8.67 (3.01)	12.00 (3.53)
4	Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 600 ml/ha	1.33 (1.34)	1.67 (1.46)	2.33 (1.68)	5.00 (2.34)	7.00 (2.73)	9.67 (3.18)
5	Chlorantraniliprole 18.5% SC @ 125 ml/ha	10.67 (3.33)	14.00 (3.80)	17.00 (4.18)	21.00 (4.63)	24.00 (4.94)	28.00 (5.33)
6	Thiamethoxam 25% WG @ 100g/ha	3.00 (1.87)	4.33 (2.20)	5.67 (2.48)	10.00 (3.23)	12.67 (3.62)	16.00 (4.05)
7	Carbofuran 3% CG @ 33300 g/ha	11.00 (3.36)	13.33 (3.69)	16.33 (4.09)	20.33 (4.56)	23.00 (4.84)	27.33 (5.27)
8	Pyriproxyfen 5% EC + Fenpropathrin 15% EC @ 750 ml/ha	11.33 (3.42)	13.67 (3.75)	16.33 (4.10)	20.67 (4.59)	24.33 (4.98)	27.00 (5.24)
	SEm ±	0.21	0.19	0.16	0.17	0.19	0.14
	CD at 5 %	0.64	0.56	0.50	0.52	0.57	0.44
	CV %	14.36	11.30	8.87	7.91	7.82	5.53

*Mean of three replications, DAA – Days After Application
Figures in parentheses are square root of √ x+ 0.5

Table 3. Effect of Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w on jassids of okra (2017)

Tr. No.	Treatments	Number of jassids/3 leaves*					
		14 DAA	21 DAA	28 DAA	35 DAA	42 DAA	49 DAA
1	Untreated	3.00 (1.86)	4.67 (2.26)	7.00 (2.72)	9.33 (3.12)	11.33 (3.43)	14.00 (3.80)
2	Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 400 ml/ha	1.67 (1.46)	2.67 (1.77)	4.33 (2.19)	6.00 (2.54)	8.00 (2.90)	10.00 (3.23)
3	Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 500 ml/ha	1.00 (1.22)	1.67 (1.46)	2.67 (1.77)	4.33 (2.19)	6.00 (2.54)	7.67 (2.84)
4	Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 600 ml/ha	0.67 (1.05)	1.33 (1.34)	2.33 (1.68)	3.33 (1.95)	5.00 (2.35)	6.67 (2.67
5	Chlorantraniliprole 18.5% SC @ 125 ml/ha	2.67 (1.76)	4.00 (2.11)	6.33 (2.60)	8.33 (2.96)	10.67 (3.34)	12.67 (3.62)
6	Thiamethoxam 25% WG @ 100g/ha	1.67 (1.46)	2.67 (1.77)	4.67 (2.26)	6.33 (2.59)	8.00 (2.90)	10.33 (3.29)
7	Carbofuran 3% CG @ 33300 g/ha	2.33 (1.68)	4.00 (2.11)	6.00 (2.54)	8.67 (3.02)	11.00 (3.38)	13.00 (3.67)
8	Pyriproxyfen 5% EC + Fenpropathrin 15% EC @ 750 ml/ha	2.00 (1.58)	4.33 (2.20)	6.33 (2.60)	9.00 (3.07)	10.67 (3.34)	13.00 (3.67)
	SEm ±	0.13	0.14	0.17	0.18	0.16	0.17
	CD at 5 %	0.40	0.41	0.51	0.55	0.50	0.50
	CV %	15.11	12.50	12.61	11.71	9.39	8.60

*Mean of three replications, DAA – Days After Application
Figures in parentheses are square root of √ x+ 0.5

Table 4. Effect of Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w on jassids of okra (2018)

Tr. No.	Treatments	Number of jassids/3 leaves*					
		14 DAA	21 DAA	28 DAA	35 DAA	42 DAA	49 DAA
1	Untreated	3.67 (2.02)	5.00 (2.34)	7.67 (2.85)	9.00 (3.08)	11.00 (3.38)	15.00 (3.94)
2	Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 400 ml/ha	2.00 (1.58)	2.67 (1.77)	4.33 (2.18)	5.67 (2.48)	7.67 (2.85)	10.67 (3.34)
3	Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 500 ml/ha	1.33 (1.34)	2.00 (1.58)	3.00 (1.86)	4.00 (2.11)	5.67 (2.48)	8.33 (2.96)
4	Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 600 ml/ha	1.00 (1.22)	1.33 (1.34)	2.67 (1.77)	3.33 (1.95)	5.00 (2.34)	7.33 (2.79)
5	Chlorantraniliprole 18.5% SC @ 125 ml/ha	3.33 (1.94)	4.67 (2.26)	6.67 (2.66)	8.67 (3.02)	10.33 (3.29)	14.00 (3.80)
6	Thiamethoxam 25% WG @ 100g/ha	2.00 (1.56)	3.00 (1.87)	4.67 (2.27)	6.00 (2.54)	7.67 (2.86)	11.00 (3.38)
7	Carbofuran 3% CG @ 33300 g/ha	3.33 (1.95)	4.33 (2.20)	7.00 (2.73)	8.67 (3.02)	10.67 (3.34)	13.67 (3.76)
8	Pyriproxyfen 5% EC + Fenpropathrin 15% EC @ 750 ml/ha	3.00 (1.87)	4.00 (2.12)	6.33 (2.60)	8.00 (2.91)	10.00 (3.24)	13.33 (3.72)
	SEm ±	0.14	0.10	0.16	0.14	0.12	0.14
	CD at 5 %	0.42	0.31	0.48	0.41	0.36	0.43
	CV %	14.34	9.28	11.66	8.91	6.94	7.06

*Mean of three replications, DAA – Days After Application
Figures in parentheses are square root of √ x+ 0.5

Table 5. Effect of Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w on leaf miner of okra (2017)

Tr. No.	Treatments	Number of mines/ leaf*					
		14 DAA	21 DAA	28 DAA	35 DAA	42 DAA	49 DAA
1	Untreated	2.33 (1.68)	4.33 (2.20)	5.67 (2.48)	6.33 (2.61)	8.33 (2.96)	11.00 (3.38)
2	Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 400 ml/ha	1.67 (1.46)	2.67 (1.77)	4.00 (2.11)	5.00 (2.34)	6.67 (2.67)	9.33 (3.13)
3	Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 500 ml/ha	1.00 (1.22)	2.00 (1.58)	3.00 (1.86)	3.67 (2.00)	5.33 (2.40)	7.67 (2.85)
4	Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 600 ml/ha	0.67 (1.05)	1.67 (1.46)	2.33 (1.68)	2.67 (1.77)	4.33 (2.19)	6.33 (2.61)
5	Chlorantraniliprole 18.5% SC @ 125 ml/ha	1.33 (1.34)	2.33 (1.68)	3.67 (2.03)	4.67 (2.26)	6.67 (2.67)	9.00 (3.08)
6	Thiamethoxam 25% WG @ 100g/ha	2.00 (1.58)	4.00 (2.11)	5.00 (2.34)	6.00 (2.54)	7.67 (2.85)	10.33 (3.29)
7	Carbofuran 3% CG @ 33300 g/ha	2.33 (1.68)	3.67 (2.04)	5.33 (2.41)	6.00 (2.54)	8.00 (2.91)	10.00 (3.24)
8	Pyriproxyfen 5% EC + Fenpropathrin 15% EC @ 750 ml/ha	2.00 (1.58)	3.67 (2.04)	4.67 (2.26)	5.67 (2.46)	7.67 (2.85)	9.67 (3.18)
	SEm ±	0.08	0.09	0.10	0.18	0.16	0.13
	CD at 5 %	0.26	0.27	0.30	0.54	0.48	0.39
	CV %	10.13	8.29	7.85	13.20	10.20	7.28

*Mean of three replications, DAA – Days After Application
Figures in parentheses are square root of √ x+ 0.5

Table 6. Effect of Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w on leaf miner of okra (2018)

Tr. No.	Treatments	Number of mines/ leaf*					
		14 DAA	21 DAA	28 DAA	35 DAA	42 DAA	49 DAA
1	Untreated	3.00 (1.86)	4.67 (2.26)	6.33 (2.60)	8.00 (2.91)	9.00 (3.08)	11.33 (3.44)
2	Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 400 ml/ha	2.00 (1.56)	3.00 (1.86)	4.67 (2.26)	6.00 (2.54)	7.33 (2.77)	9.67 (3.19)
3	Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 500 ml/ha	1.33 (1.34)	2.33 (1.68)	3.67 (2.02)	4.67 (2.27)	5.67 (2.48)	7.67 (2.85)
4	Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 600 ml/ha	1.00 (1.22)	1.67 (1.46)	2.67 (1.77)	3.33 (1.95)	4.67 (2.24)	6.33 (2.61)
5	Chlorantraniliprole 18.5% SC @ 125 ml/ha	2.00 (1.56)	2.67 (1.76)	5.00 (2.35)	5.67 (2.48)	7.00 (2.73)	9.33 (3.13)
6	Thiamethoxam 25% WG @ 100g/ha	2.67 (1.77)	4.33 (2.20)	6.00 (2.54)	7.33 (2.79)	8.00 (2.90)	10.67 (3.34)
7	Carbofuran 3% CG @ 33300 g/ha	3.00 (1.86)	4.67 (2.27)	6.33 (2.61)	7.67 (2.86)	8.67 (3.03)	10.67 (3.33)
8	Pyriproxyfen 5% EC + Fenpropathrin 15% EC @ 750 ml/ha	2.67 (1.77)	4.33 (2.18)	6.00 (2.54)	7.33 (2.80)	8.33 (2.97)	10.00 (3.23)
	SEm ±	0.13	0.14	0.15	0.10	0.17	0.13
	CD at 5 %	0.39	0.43	0.45	0.30	0.52	0.40
	CV %	13.86	12.67	11.08	6.59	10.62	7.22

*Mean of three replications, DAA – Days After Application
Figures in parentheses are square root of √ x+ 0.5

Table 7. Effect of Chlorantraniliprole 8.8% w/w+Thiamethoxam 17.5% w/w against *Earias* spp during 2017 & 2018

Tr. No.	Treatments	Per cent fruit damage caused by Earias spp*			
		2017		2018	
		42 DAA	49 DAA	42 DAA	49 DAA
1	Untreated	14.67 (22.50)	19.00 (25.82)	17.33 (24.55)	21.33 (27.46)
2	Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 400 ml/ha	6.67 (14.72)	10.33 (18.53)	8.00 (16.24)	12.00 (20.14)
3	Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 500 ml/ha	4.67 (12.36)	7.67 (15.93)	5.33 (13.34)	8.33 (16.74)
4	Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 600 ml/ha	3.33 (10.50)	5.67 (13.76)	4.33 (11.94)	6.33 (14.51)
5	Chlorantraniliprole 18.5% SC @ 125 ml/ha	6.33 (14.44)	9.67 (18.01)	7.67 (15.93)	10.67 (18.95)
6	Thiamethoxam 25% WG @ 100g/ha	12.67 (20.79)	17.00 (24.28)	14.33 (14.33)	19.33 (26.07)
7	Carbofuran 3% CG @ 33300 g/ha	9.00 (17.39)	12.33 (20.51)	10.33 (10.33)	13.67 (21.68)
8	Pyriproxyfen 5% EC + Fenpropathrin 15% EC @ 750 ml/ha	7.67 (15.99)	10.67 (19.01)	9.33 (17.75)	12.33 (20.50)
	SEm ±	1.27	1.25	1.31	1.29
	CD at 5 %	3.86	3.79	3.98	3.91
	CV %	13.69	11.12	12.93	10.77

*Mean of three replications, DAA – Days After Application
Figures in parentheses are arcsine transformed values

Table 8. Effect of Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w against *Helicoverpa armigera* during 2017 & 2018

Tr. No.	Treatments	Per cent fruit damage caused by Earias spp*			
		2017		2018	
		42 DAA	49 DAA	42 DAA	49 DAA
1	Untreated	6.00 (2.53)	7.33 (2.78)	7.00 (2.72)	8.00 (2.91)
2	Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 400 ml/ha	3.33 (1.95)	4.67 (2.27)	4.00 (2.11)	5.00 (2.34)
3	Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 500 ml/ha	2.00 (1.58)	3.00 (1.84)	2.33 (1.68)	3.33 (1.90)
4	Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 600 ml/ha	1.67 (1.46)	2.33 (1.68)	1.67 (1.46)	2.33 (1.68)
5	Chlorantraniliprole 18.5% SC @ 125 ml/ha	3.33 (1.95)	4.67 (2.26)	3.67 (2.02)	5.33 (2.41)
6	Thiamethoxam 25% WG @ 100g/ha	5.00 (2.34)	6.67 (2.67)	6.00 (2.54)	7.33 (2.79)
7	Carbofuran 3% CG @ 33300 g/ha	4.00 (2.11)	5.67 (2.48)	4.33 (2.19)	6.00 (2.54)
8	Pyriproxyfen 5% EC + Fenpropathrin 15% EC @ 750 ml/ha	3.67 (2.03)	5.00 (2.34)	4.00 (2.11)	5.33 (2.39)
	SEm ±	0.13	0.16	0.15	0.18
	CD at 5 %	0.40	0.48	0.45	0.53
	CV %	11.56	11.94	12.28	12.81

*Mean of three replications, DAA – Days After Application

Figures in parentheses are square root of √ x+ 0.5

Table 9. Effect of Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w on *Coccinellids* during 2017 and 2018

Tr. No.	Treatments	Population of *Coccinellids* (numbers per 5 plants)*	
		2017	2018
1	Untreated	1.85 (3.33)	1.72 (2.67)
2	Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 400 ml/ha	1.47 (2.00)	1.56 (2.00)
3	Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 500 ml/ha	1.18 (1.33)	1.52 (2.00)
4	Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 600 ml/ha	1.43 (2.00)	1.34 (1.33)
5	Chlorantraniliprole 18.5% SC @ 125 ml/ha	1.52 (2.00)	1.68 (2.33)
6	Thiamethoxam 25% WG @ 100g/ha	1.43 (2.00)	1.52 (2.00)
7	Carbofuran 3% CG @ 33300 g/ha	1.52 (2.00)	1.34 (1.33)
8	Pyriproxyfen 5% EC + Fenpropathrin 15% EC @ 750 ml/ha	1.27 (1.33)	1.44 (1.67)
	SEm ±	0.44	0.24
	CD at 5 %	NS	NS

*Mean of three replications

Figures in parentheses are square root of √ x+ 0.5

Table 10. Effect of Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w on yield of okra during 2017 and 2018

Tr. No.	Treatments	Yield (q/ha)	
		2017	2018
1	Untreated	86.33	83.67
2	Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 400 ml/ha	109.00	106.33
3	Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 500 ml/ha	117.33	113.00
4	Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5% w/w @ 600 ml/ha	122.33	119.33
5	Chlorantraniliprole 18.5% SC @ 125 ml/ha	102.67	99.67
6	Thiamethoxam 25% WG @ 100g/ha	100.33	98.00
7	Carbofuran 3% CG @ 33300 g/ha	96.33	94.00
8	Pyriproxyfen 5% EC + Fenpropathrin 15% EC @ 750 ml/ha	98.67	96.33
	SEm ±	2.57	2.73
	CD at 5 %	7.80	8.28
	CV %	4.28	4.67

The presented results get support from the findings of Kalyan *et al*., (2017) and Pandey (2018) that newer group of insecticides and their combinations results in better pest management in different cropping system.

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