RESEARCH ARTICLE

FIELD EVALUATION OF THIAMETHOXAM 25 WG AGAINST SUCKING PESTS IN OKRA

ABSTRACT

Two field experiments were conducted to test the efficacy of different doses of thiamethoxam against okra sucking pests viz., Aphids, *Aphis gossypii*; leaf hopper, *Amrasca biguttela biguttela*, and whitefly,*Bemisia tabaci* and their predators in okra agroecosystem. Thiamethoxam 25% WG 25 g a.i./ha (84.71-91.73, 94.12 - 98.11% reduction over control) was highly effective against aphid, whitefly and leaf hoppers with was on par with with 50 (64.28-76.90, 83.70 – 87.92% reduction over control) and 75 g a.i./ha (73.48-81.26 and 85.26-92.42% reduction over control) after first and second spray, respectively. This was further followed by standard check thiamethoxam 25% WG @ 25 g a.i./ha (Willoxam®). The plots treated with Thiamethoxam 25% WG @ 25, 50 and 75 g a.i. /ha recorded the maximum population of *Coccinella* spp recorded (4.22-5.10 and 4.33-6.21 nos.) after first and second spray. Similarly, thiamethoxam 25% WG @ 75 g a.i./ha treated plot recorded the maximum yield (8100 kg/ha) followed by thiamethoxam 25%WG @ 25 and 50 g a.i./ha (7345 and 7690.5 kg/ha).

Keywords: Thiamethoxam, Bioefficacy, sucking pests, natural enemies, phytotoxicity.

INTRODUCTION

Okra is a vegetable crop which can be predominantly grown in tropics and subtropics. Okra was originated in tropical and subtropical Africa. In India, this vegetable is called as “Bhendi”. Okra is good source of nutritional values and health benefits. The stem of the plant is used for the extraction of the fibre. Okra farming is very profitable and can be cultivated throughout the year. Okra is a source of higher fiber and good source of folate content. It containing vitamin A,B,K,C and excellent source of iodine. India is the largest producer of okra in Asia as well as in the world. In India, major okra growing states are Uttar Pradesh, Bihar and West Bengal.India rank first in the world with 5,784 thousand tones (72% of the total world production) of okra. In India Andhra Pradesh is the leading okra producing state which has production of around 1184.2 thousand tons from an area of 78.90 thousand ha, which a productivity of 15 ton/ha. Its followed by West Bengal and Bihar, 882.39, 762.90 thousand tons from an area of 75.45 and 57.71/ha, respectively (Horticultural statistics at a glance,2015). However, one of the major constrains for okra production is heavy infestations caused by several insects pests which not only exert quantitative loss but also qualitative loss to the crops. The occurrence and intensity of damage caused by them varies from different crop growth stages, regions and seasons. Again, infestations by sucking pests not only affect the crop but also hamper the crop health by transmitting pathogenic diseases.

The increasing use of conventional insecticides resulted development of resistance by the target insects and hazard to water, soil, environment and human health. This has led to the development of large numbers of new active compounds such as the neonicotinoids which were introduced as an alternative to conventional insecticides. ~~Recently,~~ neonicotinoids have been the fastest growing class of insecticides in modern crop protection with broad spectrum effect against sucking and certain chewing insect pests. These chemical insecticides act agonistically on insect Nicotinic Acetylcholine Receptors (nAChR), blocking the nicotinergic neural pathway causing accumulation of the neurotransmitter acetylcholine Pawar *et al.* (2016) reported that, mean population of aphids, jassids, and whiteflies after three sprays revealed that imidacloprid was effective and superior, the next best were thiomethoxam. Sagar Anand Pandey (2018) found that thiamethoxam 25 WG @ 0.006% was the most effective against aphids, leaf hopper and whitefly followed by Lambda cyhalothrin 5 EC @ 0.004%.

Most of the sucking pests have developed resistance to many of the conventional insecticides. The present day need emphasizes not only the use of different groups of chemicals that are eco-friendly but also give satisfactory control of insect pest population by their novel mode of action with minimum hazards to mammals and natural enemies.Though many formulations of thiamethoxam are available in the market and found efficacious against sucking pests, the research was carried out to investigate the newer indigenous formulation of thiamethoxam 25 WG developed by Crystal Crop Protection Pvt. Ltd. New Delhi against sucking insects in okra.

MATERIAL AND METHODS

Two field experiments were conducted one at Madhampatti and second at Narasimanayakkanpalayam to test the efficacy of different doses of thiamethoxam against okra sucking pests viz., Aphids, *Aphis gossypii*; leaf hopper, *Amrasca biguttela biguttela*, and whitefly,*Bemisia tabaci*. The experiments were conducted using RBD with six treatments replicated four times with a plot size of 4 x 5 m using the variety Okra / Ajeet-333. The treatments for the management of sucking pests comprised of thiamethoxam 25 % WG 15,25,50,75 and willoxam 25 g a.i.ha^{-1}. An untreatment control was simultaneously maintained during the study.The treatments were imposed commencing from 30th day after planting with pneumatic knapsack sprayer using 500 liters of spray fluid per hectare. The average temperature in the open field during the study period ranged between 27-31 °C with relative humidity ranging between 70 and 80% and there was no rainfall during the periods of observation.

The pre and post treatment observations on third, seventh and fourteenth days after treatment (DAT) were recorded on the incidence of aphids, leaf hopper and whitefly. The observations were made on three leaves/ plant, one each from top, middle and bottom regions from five plants per plot selected at random leaving border rows. The mean number of pests and per cent reduction over control were calculated for each spray. Yield also recorded from each picking for the various treatments and were pooled andexpressed in tonnes ha^{-1}.

To evaluate the phytotoxicity (if any) ~~caused~~ by thiamethoxam 25 % WG on okra, experiments were conducted one at Madhampatti and second at Narasimanayakkanpalayam(cultivar-Ajeet).Three doses were tested ~~it's comprised~~ at 25, 50 and 100 g a.i.ha^{-1}. Five plants were selected at random in each plot and the plants were examined for phytotoxic symptoms. To know the crop tolerance, the plants were observed on1, 3, 7 ,10 and 14 days after spraying as per the protocol of Central Insecticide Board Registration Committee (C.I.B. and R.C) for the phytotoxic symptoms likeleaf tip, wilting, necrosis, vein clearing, epinasty and hyponasty . The per cent leaf injury was calculated using the following formula,

$$\textit{Per cent leaf injury} = \frac{\textit{Total grade points}}{\textit{Maximum grade X Number of leaves observed}} \textit{ X 100}$$

The phytotoxicity symptoms, if any, were graded based on the per cent injured leaves as per the C.I.B and R.C). grade scale viz., no phytotoxicity – grade 0; 1-10%- grade 1;11-20%grade 2; 21-30% grade 3;31-40 % grade 4; 41-50 % grade 5; 51-60 % grade 6; 61-70 % grade 7; 71-80% grade 8; 81-90 % grade 9; 91-100% grade 10.

Ten randomly tagged plants per plot were thoroughly observed for population of natural enemies. The population of natural enemies was recorded based on number of adults of coccinellids. The observations were taken before and 3, 7 and 14 days after each spraying.

RESULTS AND DISCUSSION

The aphid population prior to first spraying was 20.17 to 23.50 per three leaves (Table.1). Thiamethoxam 25% WG at the rate of 75 ga.i.ha^{-1} reduced the mean aphid population significantly (4.35 nos. per three leaves/plant) with 91.73 per cent reduction over control followed by thiamethoxam 25% WG at 50 and 25 ga.i.ha^{-1} (4.35 and 4.90 nos. per three leaves/plant) (Fig.1) The standard check, Willoxam® at 25 g a.i. ha $^{-1}$ recorded the mean aphid population of 5.24 nos. per three leaves/plant when compared to untreated check (5.24 nos. per three leaves/plant).

Similar trend was observed during the second spray. Thiamethoxam 25% WG at 75 g a.i. ha $^{-1}$ recorded higher reduction in aphid population (0.63 nos. per three leaves/plant) with 98.11 per cent reduction over control. The standard check, Willoxam® at the rate of 25 g a.i. ha $^{-1}$ recorded the aphid population with 93.25 per cent reduction over control. The untreated check recorded the population of 33.35 nos. per three leaves/plant. Pawar *et al.,* (2016) reported that, mean population of aphids, jassids, and whiteflies after three sprays revealed that imidacloprid was effective and superior, the next best were thiomethoxam.

The mean data revealed that the highest dose of thiamethoxam @ 75 g a.i.ha^{-1}recorded minimum mean whitefly population of 2.91 and 0.87 nos. per three leaves/ plant, after the first, and second spray respectively as against untreated check (12.60 and 10.68 per three leaves/ plant) and their corresponding per cent reduction over control was 76.90 and 91.85 (Fig.1). The standard check, Willoxam ® at the rate of 25 g a.i.ha^{-1}recorded the mean population of 4.83 and 2.14 nos. per three leaves /plant, respectively after the first and second spray (Tables 2). Awaneesh Kumar *et al.*(2017) reported that Thiamethoxam 25WG @ 100g/ha was found most effective insecticide in reducing the population of whitefly followed byimidacloprid 17.8 SL @ 100 ml/ha. Prem Kumar and Ashwani Kumar (2017) found that Imidiacloprid 17.8SL was the most effective treatment indicating reduction in population of whitefly (1.33/3leaves) and jassid (1.26/3leaves), followed by Thiamethoxam 25WG. The mean population of leafhoppers prior to first spraying was 7.00 to 8.20 per three leaves plant $^{-1}$ (Table 3). Thiamethoxam 25% WG at the rate of 75 ga.i.ha^{-1} reduced the mean leaf hopper population significantly (2.17 nos. per three leaves/plant) with 81.26 per cent reduction over control followed by thiamethoxam 25% WG at 50 (2.90 nos. per three leaves/plant). The standard check, Willoxam® at the rate of 25 g a.i. ha $^{-1}$ recorded the population of 3.34 nos. per three leaves/plant when compared to untreated check (11.58 nos. per three leaves/plant). Aarwe Rajesh *et al*.(2015) revealed that Overall lowest mean of jassid recorded n the plot treated with tiamethoxam 25%WG@50 g a.i./ha followed by tiamethoxam 25%WG @ 25 a.i./ha. Ghosh *et al*.(2016). The crop protected by higher doses of Thiamethoxam 25%WG 25, 50 and 75gm a.i. (83.35% and 96.67% population of Jassids, 92.95% and 99.47% population of Aphids and 83.80% and 96.67% population of White flies, respectively in first and second spray. Gaikwad *et al.,*(2014) also reported that the thiamethoxam 25%WG was very effective against aphids. They were exhibited that thiamethoxam 25%WG recorded 1.73 average survival aphid /3 leaves/plant and was found to be significantly superior over other treatment. Manju *et al*. (2018) reported that the lowest OYVMV incidence was reported in thiamethoxam 70 WS (16.56%) followed by imidacloprid 70 WS (16.90 %) and spinosad 45 SC (19.43%).

Similar trend was observed during the second spray. Thiamethoxam 25% WG at the rate of 75 g a.i. ha $^{-1}$ recorded higher reduction in aphid population (0.93 nos. per three leaves/plant) with 92.42 per cent reduction over control (Fig.1). The standard check, Willoxam at the rate of 25 g a.i. ha $^{-1}$ recorded the mean aphid population of 1.98 nos. per three leaves/plant with 83.87 per cent reduction over control. The untreated check recorded the population of 12.28 nos. per three leaves/plant. Bade *et al*.(2017) found that acetamiprid 20 SP @ 15 g a.i./ha and thiamethoxam 25 WG @ 25 g a.i./ha were found most effective treatment against aphids after four sprays.

Patil *et al*.(2014) The cumulative effect of foliar spray of Thiamethoxam 25 WG @ 0.006% was found the most effective against aphids, leaf hoppers and whitefly population. Thiamethoxam 25 WG @ 0.006% was effective against leafhoppers population followed by Thiamethoxam 25 WG @ 0.008%.Also; in case of whitefly the effective treatment recorded was Thiamethoxam 25 WG @ 0.006%. The recommended doses of insecticides were found more effective than other doses. The highest fruit yield (126.14 q/ha) and cost benefit ratio (1:12.62) were obtained from imidacloprid and thiamethoxam, respectively. Nitenpyram (NIT) and thiamethoxam (THX) are NIs that have recently been reported to be highly effective for controlling the piercing sucking pests (mainly aphids, mirids, thrips and whiteflies) (Wettstein *et al.*, 2016; Zhang et al., 2016b). Karthik *et al*.(2015) revealed that imidacloprid effective against aphids, leaf hopper and whitefly. Pawar *et al.,* (2016) reported that, mean population of aphids, jassids, and whiteflies after three sprays revealed that imidacloprid was effective and superior, the next best were thiomethoxam. Sagar Anand Pandey (2018) found that thiamethoxam 25 WG @ 0.006% was the most effective against aphids, leaf hopper and whitefly followed by Lambda cyhalothrin 5 EC @ 0.004%.

Hemadri *et al*. (2018) revealed ~~that~~ application of imidacloprid 17.8 SL @ 0.5 ml/l was found superior over the other treatments with higher per cent reduction (85.21 per cent) of pest population, followed by acetamiprid 20 SP @ 0.5 g/l, thiamethoxam 25 WG @ 0.3 g/l. Babita Bhatt *et al*. (2018) reported that thiamethoxam 25% WG@ 25 g a.i./ha, gave the good results against aphids (75.99% and 76.27% reduction over control) after first and second spray, respectively. Mane and Randhir Kumar(2019) reported that the modules treatment differed significantly and found to be superior over control. Among the modules under test, chemical modules (thiamethoxam 70 WS@3gm/kg) have significantly lowest population of jassids (2.99 per 3 leaves).

The data recorded on the yield of bhendi, on the first trial indicated that thiamethoxam 25% WG at 75 g a.i. ha^{-1} (8100.50 kg ha^{-1}) exhibited significantly higher yield over rest of the treatments (Table 7). thiamethoxam 25% WG at 50 g a.i. ha^{-1} (7690.50 kg ha^{-1}) was on par with thiamethoxam 25% WG at 25 g a.i. ha^{-1} (7345.00 kg ha^{-1}) (Fig.2).The lower dose of thiamethoxam 25% WG at 15g a.i. ha^{-1} recorded yield of 5726.50 kg ha^{-1}. Similar results were observed by Anitha and Nandihalli (2009) who evaluated the efficacy of Thiamethoxam 25 WG (0.2 g/lit.) when applied as foliar sprays and registered highest fruit yield. Similarly, Venkataravanappa *et al*. (2012) reported that thiamethoxam 25 WG gave highest fruit yield of okra. Babita Bhatt *et al*.(2018) reported that chlorantraniliprole 18.5% SC @ 25 g a.i./ha treated plot recorded the maximum yield (10.81 T/ha) followed by thiamethoxam 25%WG @ 25 g a.i./ha (9.63 T/ha). Manju *et al*. (2018) reported ~~that~~ Maximum marketable fruit yield of 122 q/ha ~~was recorded~~ in thiamethoxam 70 WS followed by Imidacloprid 70 WS (115 q/ha).

The phytotoxic effect of thiamethoxam 25 % WGon okra variety Ajeet -333 revealed that okra plants sprayed with thiamethoxam 25 % WG each at 25, 50 and 100 g a.i.ha^{-1}doses did not show any phytotoxic effects like epinasty, hyponasty, leaf injury, wilting, vein clearing and necrosis.

The coccinellid population prior to application of insecticides ranged from 5.50 to 6.67 per ten plants (Table 4). Significant differences were observed in coccinellid population among the treatments after insecticidal application. At 14 days after first spray, the plots treated with thiamethoxam 25 % WG at the rate of 15 g a.i. ha^{-1} recorded 6.25 coccinellids per ten plants followed by thiamethoxam 25 % WG at the rate of 25 g a.i. ha^{-1} (5.10 nos. 10 $plants^{-1}$). The standard check, Willoxam (Thiamethoxam 25 % WG) at the rate of 25 g.a.i. ha^{-1} (4.77 nos. 10 $plants^{-1}$) as against maximum population of coccinellids found in untreated plots (8.33 nos. 10 $plants^{-1}$).

The plots treated with thiamethoxam 25 % WG at the rate of 15 g a.i. ha^{-1} recorded a mean coccinellid population per ten plants of 6.80 followed by thiamethoxam 25 % WG at the rate of 25 g a.i. ha^{-1} (6.11 nos. 10 $plants^{-1}$). The higher dose of thiamethoxam 25 % WG at the rate of 75 g a.i. ha^{-1} recorded mean population of 4.33 nos. 10 $plants^{-1}$. The standard check, Willoxam (thiamethoxam 25 % WG) at the rate of 25 g .a.i. ha^{-1} (5.77 nos. 10 $plants^{-1}$). The untreated control recorded the highest coccinellid population of 12.33 per ten plants (Fig.3). Moscardini *et al.* (2015) reported that thiamethoxam used as seed treatments in sunflower fields negatively affected ladybeetles (*Coleomegilla maculata* and *Hippodamia convergens*). Zala *et al*. (2015) reported that Thiamethoxam 25WG@ 0.0125% was relatively safer to the activity of spiders in okra ecosystem by recording the highest population

From the present study found that thiamethoxam 25WG @ 25 g a.i.ha^{-1} are the effective chemicals and more effective against for sucking pest population (aphids, leaf hopper and whitefly). However, among all the treatments thiamethoxam 25WG @ 15 g a.i.ha^{-1} was highly safer to the predator population which was on par with 25g a.i.ha^{-1}. Thus, these chemicals can be the potent component in IPM module for okra.

CONCLUSION

The results of the two field experiments conducted to assess the efficacy of thiamethoxam against the sucking pests on okra revealed that, Thiamethoxam 25% WG 25 g a.i./ha (84.71-91.73, 94.12 - 98.11% reduction over control) was highly effective against aphid, whitefly and leaf hoppers with was on par with with 50 g a.i./ha (64.28-76.90, 83.70 – 87.92% reduction over control) and 75 g a.i./ha (73.48-81.26 and 85.26-92.42% reduction over control) after first and second spray, respectively. Hence Thiamethoxam 25% WG 25 g a.i./ha is sufficient and may be as field recommended does to suppress the sucking pests in okra.

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Table 1.Effect of thiamethoxam25 % WG on aphids in okra (Pooled mean of two seasons)

S.No	Treatments	PTC	Number/ 3 leaves/ plant*			Mean	Percent reduction over check	Number/ 3 leaves/ plant*			Mean	Percent reduction over check
			3 DAT	7 DAT	14 DAT			3 DAT	7 DAT	14 DAT		
1.	Thiamethoxam 25 % WG @15 g a.i ha^{-1}	20.63	9.57^{c} (3.16)	7.37^{bc} (2.80)	5.10^{bc} (2.37)	7.34	72.09	4.07^{b} (2.13)	3.87^{b} (2.09)	3.93^{b} (2.10)	3.95	88.15
2.	Thiamethoxam 25 % WG @25 g a.i ha^{-1}	21.43	7.20^{bc} (2.77)	5.07^{b} (2.36)	2.43^{ab} (1.69)	4.90	84.71	2.03^{ab} (1.58)	1.90^{b} (1.54)	1.97^{ab} (1.57)	1.96	94.12
3.	Thiamethoxam 25 % WG @50g a.i ha^{-1}	20.17	6.23^{ab} (2.59)	4.53^{ab} (2.24)	2.30^{a} (1.41)	4.35	86.42	1.97^{ab} (1.56)	1.73^{ab} (1.47)	1.80^{ab} (1.50)	1.83	94.51
4.	Thiamethoxam 25 % WG @75g a.i ha^{-1}	23.50	4.37^{a} (2.16)	2.37^{a} (1.67)	1.23^{a} (1.30)	2.65	91.73	0.70^{a} (1.09)	0.57^{a} (1.03)	0.63^{a} (1.06)	0.63	98.11
5.	Thiamethoxam 25 % WG @25 g a.i ha^{-1} (Willoxam)	22.87	7.70^{bc} (2.85)	5.53^{b} (2.37)	2.50^{ab} (1.65)	5.24	83.65	2.43^{ab} (1.71)	2.10^{ab} (1.61)	2.23^{ab} (1.65)	2.25	93.25
6.	Untreated check	20.73	34.37^{d} (5.90)	31.90^{d} (5.69)	29.90^{c} (5.51)	32.05	-	32.50^{c} (5.74)	34.27^{c} (5.90)	33.30^{c} (5.81)	33.35	-

PTC – Pre treatment count; DAT – Days after treatment ; *Mean of four replications

Figures in parentheses are $\sqrt{x+0.5}$ transformed values

In a column, means followed by a common letter(s) are not significantly different by DMRT (p=0.05)

Table 2.Effect of thiamethoxam25 % WG on whiteflies in okra (Pooled mean of two seasons)

S.No	Treatments	PTC	Number/ 3 leaves/ plant*			Mean	Percent reduction over check	Number/ 3 leaves/ plant*			Mean	Percent reduction over check
			3 DAT	7 DAT	14 DAT			3 DAT	7 DAT	14 DAT		
1.	Thiamethoxam 25 % WG @15 g a.i ha^{-1}	12.47	4.97 (2.23)^{b}	5.20 (2.28)^{b}	6.50 (2.55)^{c}	5.55	55.95	2.73 (1.65)^{b}	2.73 (1.65)^{b}	2.20 (1.48)^{b}	2.55	76.12
2.	Thiamethoxam 25 % WG @25 g a.i ha^{-1}	12.00	4.07 (2.02)^{ab}	4.13 (2.03)^{ab}	5.30 (2.30)^{bc}	4.50	64.28	2.00 (1.41)^{ab}	1.80 (1.34)^{ab}	1.43 (1.20)^{ab}	1.74	83.70
3.	Thiamethoxam 25 % WG @50g a.i ha^{-1}	11.53	3.47 (1.86)^{ab}	3.53 (1.88)^{ab}	4.90 (2.21)^{ab}	3.96	68.57	1.73 (1.32)^{ab}	1.33 (1.15)^{ab}	0.83 (0.91)^{ab}	1.29	87.92
4.	Thiamethoxam 25 % WG @75g a.i ha^{-1}	12.10	2.07 (1.44)^{a}	3.27 (1.81)^{a}	3.40 (2.10)^{a}	2.91	76.90	1.33 (1.15)^{a}	1.00 (1.00)^{a}	0.30 (0.55)^{a}	0.87	91.85
5.	Thiamethoxam 25 % WG @25 g a.i ha^{-1} (Willoxam)	12.90	4.40 (2.10)^{ab}	4.40 (2.10)^{ab}	5.70 (2.39)^{bc}	4.83	61.66	2.27 (1.51)^{ab}	2.47 (1.57)^{ab}	1.70 (1.30)^{ab}	2.14	79.96
6.	Untreated check	12.93	14.33 (3.65)^{c}	12.47 (3.53)^{c}	11.00 (3.32)^{d}	12.60	-	10.59 (3.25)^{c}	11.23 (3.35)^{c}	10.23 (3.20)^{c}	10.68	-

PTC – Pre treatment count; DAT – Days after treatment ; *Mean of four replications

Figures in parentheses are $\sqrt{x+0.5}$ transformed values

In a column, means followed by a common letter(s) are not significantly different by DMRT (p=0.05)

Table 3.Effect of thiamethoxam25%WG on leaf hopper (Pooled mean of two seasons)

S.No	Treatments	PTC	Number/ 3 leaves/ plant*			Mean	% reduction over check	Number/ 3 leaves/ plant*			Mean	% reduction over check	Yield* (Kg/ha)
			3 DAT	7 DAT	14 DAT			3 DAT	7 DAT	14 DAT			
1.	Thiamethoxam 25 % WG @15 g a.i ha^{-1}	12.47	4.83 (2.20)^{b}	2.50 (1.58)^{b}	4.40 (2.10)^{b}	3.91	66.23	3.50 (1.87)^{c}	2.00 (1.41)^{b}	1.27 (1.13)^{b}	2.25	81.67	5726.50^{c}
2.	Thiamethoxam 25 % WG @25 g a.i ha^{-1}	12.00	3.40 (1.84)^{ab}	2.23 (1.49)^{ab}	3.60 (1.90)^{b}	3.07	73.48	2.93 (1.71)^{bc}	1.50 (1.22)^{ab}	1.00 (1.00)^{ab}	1.81	85.26	7345.00^{b}
3.	Thiamethoxam 25 % WG @50g a.i ha^{-1}	11.53	3.17 (1.78)^{ab}	2.00 (1.41)^{ab}	3.53 (1.88)^{ab}	2.90	74.95	2.73 (1.65)^{b}	1.50 (1.22)^{ab}	0.80 (0.89)^{ab}	1.67	86.40	7690.50^{b}
4.	Thiamethoxam 25 % WG @75g a.i ha^{-1}	12.10	2.63 (1.62)^{a}	1.50 (1.22)^{a}	2.40 (1.55)^{a}	2.17	81.26	1.40 (1.18)^{a}	1.00 (1.00)^{a}	0.40 (0.63)^{a}	0.93	92.42	8100.50^{a}
5.	Thiamethoxam 25 % WG @25 g a.i ha^{-1} (Willoxam)	12.90	3.70 (1.92)^{ab}	2.00 (1.41)^{ab}	4.33 (2.08)^{b}	3.34	71.15	3.13 (1.77)^{bc}	1.70 (1.30)^{ab}	1.13 (1.06)^{ab}	1.98	83.87	6915.00^{bc}
6.	Untreated check	12.93	11.07 (3.33)^{c}	11.50 (3.39)^{c}	12.17 (3.49)^{c}	11.58	-	11.13 (2.85)^{d}	12.50 (2.92)^{c}	13.23 (3.04)^{c}	12.28	-	4936.00^{d}

PTC – Pre treatment count; DAT – Days after treatment ; *Mean of four replications

Figures in parentheses are $\sqrt{x+0.5}$ transformed values

In a column, means followed by a common letter(s) are not significantly different by DMRT (p=0.05)

Table 4. Effect of thiamethoxam 25 % WG on coccinellids in okra eco system (Pooled mean of two seasons)

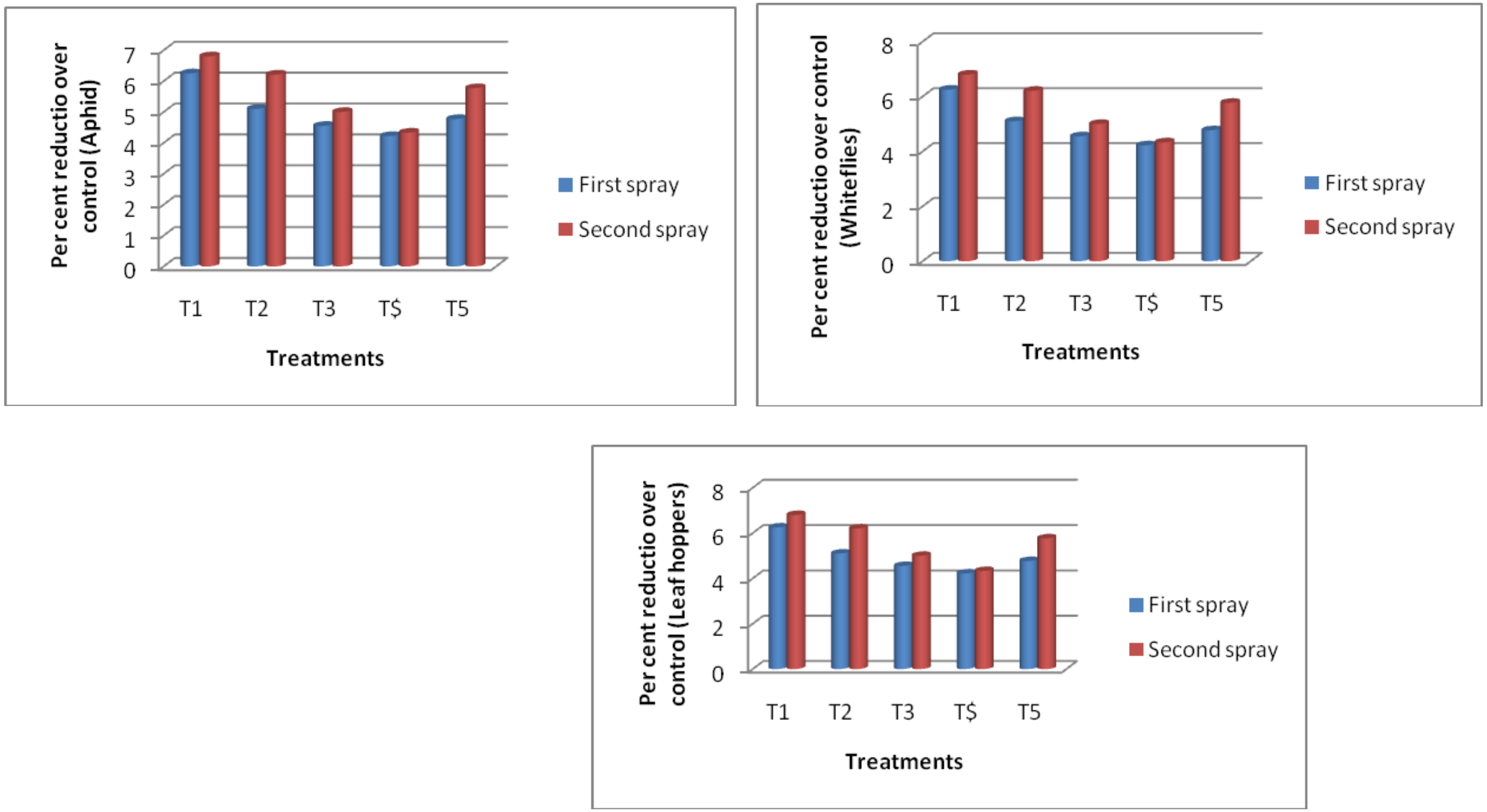
S.No	Treatments	PTC	Coccinellid population (Nos./ 10 plants)			Mean	Coccinellid population (Nos./ 10 plants)			Mean
			3 DAT	7 DAT	14 DAT		3 DAT	7 DAT	14 DAT	
T1	Thiamethoxam 25 % WG @15 g a.i ha^{-1}	7.00	5.67 (2.48)^{b}	6.17 (2.58)^{b}	6.93 (2.72)^{b}	6.25	4.60 (2.25)^{b}	7.13 (2.76)^{b}	8.67 (3.02)^{b}	6.80
T2	Thiamethoxam 25 % WG @25 g a.i ha^{-1}	6.00	4.66 (2.26)^{bc}	5.00 (2.33)^{bc}	5.66 (2.46)^{bc}	5.10	3.65 (2.03)^{bc}	6.66 (2.67)^{bc}	8.33 (2.97)^{b}	6.21
T3	Thiamethoxam 25 % WG @50g a.i ha^{-1}	6.00	4.33 (2.19)^{bc}	4.66 (2.25)^{bc}	4.66 (2.25)^{c}	4.55	3.35 (2.00)^{bc}	5.00 (2.33)^{bc}	6.66 (2.67)^{bc}	5.00
T4	Thiamethoxam 25 % WG @75g a.i ha^{-1}	5.50	4.00 (2.11)^{bc}	4.00 (2.11)^{c}	4.66 (2.27)^{c}	4.22	3.00 (1.87)^{bc}	4.00 (2.11)^{c}	6.00 (2.54)^{c}	4.33
T5	Thiamethoxam 25 % WG @25 g a.i ha^{-1} (Willoxam)	6.67	4.00 (2.11)^{bc}	5.33 (2.41)^{bc}	5.00 (2.33)^{bc}	4.77	4.00 (2.11)^{bc}	6.00 (2.53)^{bc}	7.33 (2.79)^{b}	5.77
T6	Untreated check	6.00	7.33 (2.97)^{a}	8.33 (2.97)^{a}	9.33 (3.13)^{a}	8.33	11.33 (2.97)^{a}	12.66 (3.62)^{a}	13.00 (3.67)^{a}	12.33

PTC- Pre treatment count; DAT- Days after treatments, *Mean of four replications

Values in parentheses are $\sqrt{x+0.5}$ transformed values

In a column means followed by a common letter(s) are not significantly different by DMRT (P=0.05)

Fig.1. Effect of thiamethoxam25%WG on aphid, whiteflies and hoppers leaf hopper



T1	Thiamethoxam 25 % WG @ 15 g a.i ha^{-1}
T2	Thiamethoxam 25 % WG @ 25 g a.i ha
T3	Thiamethoxam 25 % WG @ 50 g a.i ha
T4	Thiamethoxam 25 % WG @ 75 g a.i ha
T5	Thiamethoxam 25 % WG (Willoxam) @ 25 g a.i ha
T6	Untreated control

Fig 2. Impact of Insecticides on yield of okra (Pooled mean of two seasons)

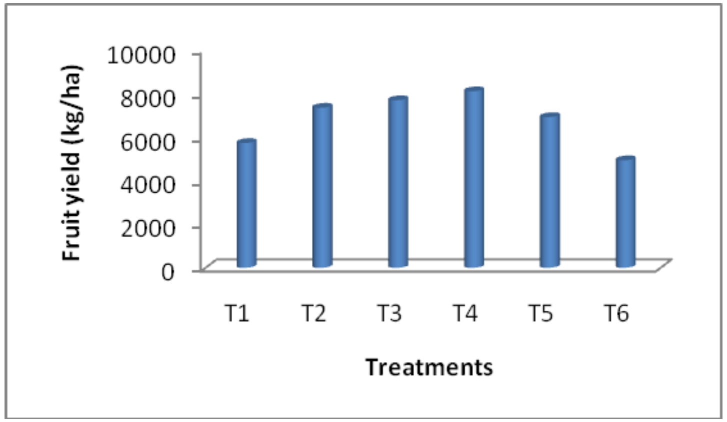
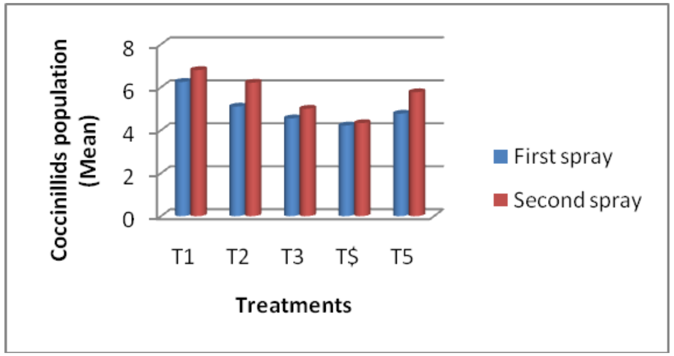


Fig 3. Effect of thiamethoxam 25 % WG on coccinellids in okra eco system (Pooled mean of two seasons)



T1	Thiamethoxam 25 % WG @ 15 g a.i ha^{-1}	T4	Thiamethoxam 25 % WG @ 75 g a.i ha
T2	Thiamethoxam 25 % WG @ 25 g a.i ha	T5	Thiamethoxam 25 % WG (Willoxam) @ 25 g a.i ha
T3	Thiamethoxam 25 % WG @ 50 g a.i ha	T6	Untreated control