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Bioefficacy of Thiamethoxam (ACTARA 25WG) against sugarcane whitefly *Aleurolobus barodensis* Maskell

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ABSTRACT
The whitefly population was ranged between 39.97-43.20 in Lalapettai and 103.86 – 119.44 / 4cm^2 leaf area in Saptur. The cumulative reduction of whitefly population due to three applications of insecticides varied from 51.01 and 74.10 when compared to 62.41 and 63.96 per cent in standard checks imidacloprid and dimethoate respectively in Lalapettai and 52.54-78.98 per cent 14 DAT at the lowest (25 g a.i) and the highest (200 g a.i) doses respectively when compared to 63.05 and 68.21 in standard checks in Saptur. The order of efficacy of various treatments was thiamethoxam (200 > 100g) > dimethoate > imidacloprid > thiamethoxam (50 > 25g a.i./ha).

Key words : Sugarcane whitefly, Thiamethoxam, Bioefficacy

INTRODUCTION

Sugarcane is one of the important commercial crops in the tropics and serves as the main source of sugar in the world. Sugarcane is known to be attacked by about 228 insects and non-insect pests in India (David and Nandagopal , 1986). Sucking pest like whiteflies are the major constrain in the cane production. There are three species of whiteflies *viz*, *Aleurolobus barodensis* Maskell, *Neomaskellia bergii* Sign and *Neomaskellia andropogonis* Corbett attacking the sugarcane. Among them, *A. barodensis* is the important one. The leaves turn yellow and/or pinkish in case of severe infestation. It's attack in the early stages of crop growth results in a serious set back to the crop and at the later stages causes deterioration in the quality of juice. In addition, sooty mould develops on the honey-dew exuded by this insect, interfers with the photosynthetic activities of the leaves, render the tops of canes unfit as cattle feed. The losses by this pest to the tune of 15-20 per cent in cane yield and 1-2 units in sugar recovery and 41.9 per cent in sucrose content of juice have been reported by Gupta and Nagar (1951) and (Singh *et al.,* 1956). Earlier several contact insecticides *viz.,* BHC, lindane, toxaphane, chlordane, endrin, dieldrin, parathion, malathion and diazinon have been recommended for the control of this pest by different workers (Basheer, 1956; Khan and Krishnamurthy Rao, 1956; Singh e*t al.,* 1956; Siddiqi and Agarwal, 1957; Siddiqi and Saxena, 1960; Rajani, 1960; Rajani, 1961; Singh and Haq, 1968; Gupta and Shankar Singh, 1971). Systemic insecticides *viz.,* methyl demeton, phosphamidon, monocrotophos, thiometon, formothion and dimethoate which could be more effective than contact insecticides against nymphs and puparia (Chaudhary *et al.,* 1985).Hence an attempt has been made to evaluate new molecule of insecticide, thiamethoxam against this pest.

MATERIALS AND METHODS

Bioassay :

Ten cm length of whitefly infested leaf strips were cut and dipped in the corresponding insecticide solution and kept them in a beaker containing water which maintains the leaf as fresh for about 48hrs. The observations were made 48 hours after the treatment.

Field experiment :

Two field trials were conducted at Lalapettai, Karur district and Saptur, Madurai district in a completely randomized block design to assess the bioefficacy of thiamethoxam against whitefly. In the trials, imidacloprid and dimethoate were included as standard checks. Six month old sugarcane crop with natural infestation of the white flies were selected for the study. Insecticides were sprayed to run off point using a high volume sprayer. The spray fluid used was 1000 litres per ha. In all experiments an untreated check was included.

Pest assessment :

The incidence of whitefly was observed on five randomly selected canes in each plot. In each cane three consecutive leaves from top were selected and in each leaves three places of 4cm^2 area of leaf was observed for pest population. The whiteflies were pricked with a pin and those from which fluid oozed out were considered to be living.

RESULTS AND DISCUSSION

The bio assay results revealed that the population prior to the treatment ranged between 190.00 and 196.67 /10 cm length of leaf. Thiamethoxam effected population reduction by 71.05 - 87.63 per cent, when compared to 82.61 per cent and 85.75 per cent in standard checks imidacloprid and dimethoate respectively (Table 1).

In the field trials the population of whitefly prior to first application was 39.97-43.12 in Lalapettai and 103.86 – 119.44 / 4 cm^2 leaf area in Saptur. The cumulative effect observed by three applications of thiamethoxam was to the extent of 51.01—74.10 when compared to 62.41 and 63.96 per cent in standard checks imidacloprid and dimethoate respectively (Table 5) in Lalapettai and the cumulative effect was slightly higher in Saptur. However the trend was same as observed in Lalapettai and the effect was dose dependent; the extent being 31.39-52.36 per cent in 14 DAT at lowest (25 g a.i) and highest (200 g a.i) doses respectively. There was further increase in reduction after second application; the extent being 52.54-78.98 per cent in 14 DAT at the lowest (25 g a.i) and the highest (200 g a.i) doses respectively when compared to 63.05 and 68.21 in standard checks imidacloprid and dimethoate respectively (Table 9). The order of efficacy of various treatments was, thiamethoxam (200 > 100g) >

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Table 1 : Bio assay of thiamethoxam against sugarcane whitefly

Treatment	Dose (g a.i/ha)	Pre count (mean/ 10 cm length of leaf)	Percent reduction over control
Thiamethoxam 25 WG	25	194.33	71.05 (19.01)[f]
Thiamethoxam 25 WG	50	196.67	79.82 (26.43)[e]
Thiamethoxam 25 WG	100	191.00	85.08 (37.51)[b]
Thiamethoxam 25 WG	200	190.00	87.63 (48.73)[a]
Imidacloprid 200 SL	50	190.66	82.61 (34.72)[d]
Dimethoate 30 EC	750	191.67	85.75 (36.72)[c]
Untreated check	-	193.33	-

Means followed by a common letter are not significantly (p = 0.05) different by DMRT
Figures in parentheses are arcsine $\sqrt{P}$; where P is the corrected per cent mortality

Table 2 : Bio efficacy of thiamethoxam against sugarcane whitefly-Lalapettai- first application

Treatment	Dose (g.ai./ha)	Pre count (mean/ 4cm^2 leaf area)	Percent reduction over control-DAT			
			1	3	7	14
Thiamethoxam 25 WG	25	40.12	1.97 (8.06)[f]	26.07 (30.70)[f]	38.2 (38.17)[f]	7.47 (15.86)[f]
Thiamethoxam 25 WG	50	41.17	6.97 (15.30)[d]	32.1 (34.51)[e]	44.76 (41.99)[d]	12.74 (20.90)[d]
Thiamethoxam 25 WG	100	40.93	5. 85 (13.99)[e]	49.03 (44.44)[b]	51.29 (45.74)[c]	13.12 (21.23)[c]
Thiamethoxam 25 WG	200	43.12	14.72 (22.55)[b]	59.75 (50.63)[a]	67.42 (55.21)[a]	25.80 (30.52)[a]
Imidacloprid 200 SL	50	42.81	16.69 (24.10)[a]	34.83 (36.16)[d]	39.67 (39.03)[e]	20.58 (26.99)[b]
Dimethoate 30 EC	750	39.97	12.19 (20.43)[c]	44.75 (41.98)[c]	38.32 (49.79)[b]	11.04 (19.40)[e]
Untreated check	-	43.20	43.61*	43.84*	44.01*	44.41*

* Whitefly population in Untreated check
Means followed by a common letter are not significantly (p = 0.05) different by DMRT
Figures in parentheses are arcsine $\sqrt{P}$; where P is the corrected per cent mortality
DAT: days after treatment

Table 3 : Bio efficacy of thiamethoxam against sugarcane whitefly -Lalapettai - second application

Treatment	Dose (g.a./ha)	Pre count (mean/ 4cm^2 leaf area)	Percent reduction over control-DAT			
			1	3	7	14
Thiamethoxam 25 WG	25	39.9	7.99 (16.41)[e]	36.57 (37.20)[d]	41.63 (40.15)[e]	11.28 (19.62)[f]
Thiamethoxam 25 WG	50	39.4	32.20 (34.56)[c]	43.93 (41.41)[c]	48.11 (43.91)[c]	22.97 (21.10)[c]
Thiamethoxam 25 WG	100	36.3	39.52 (38.95)[b]	51.52 (45.87)[b]	60.37 (50.99)[b]	33.38 (35.44)[c]
Thiamethoxam 25 WG	200	38.41	57.23 (49.16)[a]	59.18 (50.26)[a]	70.90 (57.38)[a]	49.15 (43.94)[a]
Imidacloprid 200 SL	50	34.71	31.83 (34.34)[c]	24.40 (29.59)[f]	42.76 (40.83)[d]	24.37 (29.77)[b]
Dimethoate 30 EC	750	36.3	20.45 (26.87)[d]	28.56 (32.29)[e]	43.68 (41.36)[d]	23.18 (28.28)[d]
Untreated check	-	44.1	45.66*	45.93*	46.01*	46.01*

* Whitefly population in Untreated check
Means followed by a common letter are not significantly (p = 0.05) different by DMRT
Figures in parentheses are arcsine $\sqrt{P}$; where P is the corrected per cent mortality
DAT: days after treatment

Table 4 **:** Bio efficacy of thiamethoxam against sugarcane whitefly -Lalapettai - third application

Treatment	Dose (g.ai./ha)	Pre count (mean/ 4cm^2 leaf area)	Percent reduction over control-DAT			
			1	3	7	14
Thiamethoxam 25 WG	25	36.06	17.06 (24.39) [e]	13.92 (21.90) [e]	23.98 (29.26) [e]	22.87 (28.56) [f]
Thiamethoxam 25 WG	50	35.69	22.61 (28.39) [c]	24.10 (29.40) [d]	32.37 (34.67) [d]	37.33 (37.65) [d]
Thiamethoxam 25 WG	100	33.6	43.95 (41.52) [a]	57.31 (49.21) [b]	70.99 (57.43) [a]	63.34 (52.75) [a]
Thiamethoxam 25 WG	200	32.4	44.21 (41.67) [a]	61.39 (51.59) [a]	72.48 (58.39) [a]	61.72 (51.78) [b]
Imidacloprid 200 SL	50	31.01	39.55 (38.96) [b]	36.74 (37.30) [c]	54.77 (47.74) [b]	40.03 (39.24) [c]
Dimethoate 30 EC	750	32.92	21.82 (27.84) [d]	36.48 (37.15) [c]	49.43 (44.67) [c]	30.13 (33.28) [e]
Untreated check	-	46.01	46.66*	46.93*	47.01*	47.33*

* Whitefly population in Untreated check
Means followed by a common letter are not significantly (p = 0.05) different by DMRT
Figures in parentheses are arcsine $\sqrt{P}$; where P is the corrected per cent mortality
DAT: days after treatment

Table 5 : Cumulative effect of thiamethoxam against sugarcane whitefly -Lalapettai

Treatment	Dose (g.ai./ha)	Pre count (mean/ 4cm^2 leaf area)	Cumulative Percent reduction over control 14 DAT	
			II / I Spray	III / I Spray
Thiamethoxam 25 WG	25	40.12	27.18 (31.42)f	51.01 (45.58)f
Thiamethoxam 25 WG	50	41.17	38.25 (38.20)e	57.18 (49.12)e
Thiamethoxam 25 WG	100	40.93	49.12 (44.49)b	71.78 (57.91)d
Thiamethoxam 25 WG	200	43.12	52.74 (46.57)a	74.10 (59.40)c
Imidacloprid 200 SL	50	42.81	42.57 (40.72)d	62.41 (52.18)b
Dimethoate 30 EC	750	39.97	47.03 (43.29)c	63.96 (53.10)a
Untreated check	-	43.20	-	-

Means followed by a common letter are not significantly (p = 0.05) different by DMRT
Figures in parentheses are arcsine $\sqrt{P}$; where P is the corrected per cent mortality
DAT: days after treatment

dimethoate > imidacloprid > thiamethoxam (50 > 25g).

Foliar application of thiamethoxam reduced the population of *A. barodensis* to the extent of 51.01 to 74.10 , 52.54 to 78.98 and 58.10 per cent at the doses tested (25 , 50 ,100 and 200 g a.i./ ha). The efficacy was confirmed by multilocation trials. Imidacloprid effected 57.92 and 63.05 per cent reduction. High susceptibility of other sucking pests like aphids, *Aphis craccivora* Koch*, A. gossypii*, *Myzus persicae* Sulzer (Mathirajan and Regupathy, 2001), leafhoppers, *Amrasca biguttula biguttula* Ishida*, A. devastans* (Patil *et al*., 2004; Mathirajan and Regupathy, 2001), plant hoppers, *Nilaparvata lugens* Stal and *Sogatella furcifera* Horvath (Mathirajan and Regupathy, 2002), hopper, *Amritodus atkinsoni* Lethierry (Nagangoud *et al*.,2003) and *Thrips tabacci* (Praveen, 2003) to thiamethoxam and imidacloprid was well documented. The physico-chemical properties of thiamethoxam render them useful for a wide range of application techniques, including foliar, seed treatment, soil drench, and stem application (Denholm *et al.,* 2002). Most of the target sucking pest species colonize plant leaves and feed on the

Table 6 : Bio efficacy of thiamethoxam against sugarcane whitefly -Saptur- first application

Treatment	Dose (g.ai./ha)	Pre count (mean/ 4cm^2 leaf area)	Percent reduction over control			
			1	3	7	14
Thiamethoxam 25 WG	25	109.98	7.23 (15.59)^c	23.29 (28.85)^d	26.88 (31.22)^d	18.32 (25.34)^e
Thiamethoxam 25 WG	50	118.83	7.51 (15.00)^b	25.00 (30.00)^c	38.07 (38.09)^b	25.29 (28.65)^c
Thiamethoxam 25 WG	100	119.44	10.07 (18.50)^a	33.97 (35.65)^b	38.37 (38.27)^b	25.01 (30.00)^b
Thiamethoxam 25 WG	200	111.93	10.18 (18.60)^a	34.52 (35.98)^a	45.64 (42.49)^a	36.99 (37.30)^a
Imidacloprid 200 SL	50	106.01	6.07 (14.26)^d	20.19 (26.70)^e	26.99 (31.37)^d	21.99 (27.55)^d
Dimethoate 30 EC	750	103.86	4.69 (12.50)^e	19.99 (26.55)^e	33.24 (35.2)^e	28.34 (32.35)^e
Untreated check	-	109.78	110.00*	111.51*	112.82*	113.00*

* Whitefly population in Untreated check
Means followed by a common letter are not significantly (p = 0.05) different by DMRT
Figures in parentheses are arcsine $\sqrt{P}$; where P is the corrected per cent mortality
DAT: days after treatment

Table 7: Bio efficacy of thiamethoxam against sugarcane whitefly - Saptur - second application

Treatment	Dose (g.ai./ha)	Pre count (mean/ 4cm^2 leaf area)	Percent reduction over control			
			1	3	7	14
Thiamethoxam 25 WG	25	99.07	11.20 (19.55)^c	34.57 (36.01)^c	37.63 (37.83)^d	21.01 (25.85)^e
Thiamethoxam 25 WG	50	90.33	13.25 (21.34)^b	42.33 (40.58)^b	48.01 (42.86)^c	32.33 (34.20)^c
Thiamethoxam 25 WG	100	91.20	15.87 (23.47)^a	57.33 (49.21)^a	67.01 (54.94)^b	34.67 (36.78)^b
Thiamethoxam 25 WG	200	101.33	16.04 (23.61)^a	58.01 (49.61)^a	69.33 (56.37)^a	36.33 (37.87)^a
Imidacloprid 200 SL	50	104.4	9.09 (17.54)^d	28.57 (32.31)^d	42.40 (40.69)^e	22.58 (28.97)^d
Dimethoate 30 EC	750	93.40	18.47 (24.92)^e	34.01 (36.34)^e	47.33 (42.06)^d	31.47 (33.70)^f
Untreated check	-	113.40	113.61*	114.85*	116.04*	116.58*

*Whitefly population in Untreated check
Means followed by a common letter are not significantly (p = 0.05) different by DMRT
Figures in parentheses are arcsine $\sqrt{P}$; where P is the corrected per cent mortality
DAT: days after treatment

vascular system and so the insecticidal action of neonicotinoids undoubtfully depends also on the symplastic and apoplastic availability of the ingredient (Buchholz and Nauen, 2001). Thiamethoxam is reported to have excellent acropetal translocation in the xylem and no basipetal movement in the phloem. The properties of thiamethoxam, *viz.,* low molecular mass, a relatively high water solubility and low partition coefficient favour rapid and efficient uptake in plants and xylem transport (Maienfisch *et al.,* 2001). Dimethoate caused 63.96 and 68.21 per cent reduction in whitefly population, as was observed by Chaudhary *et al.* (1985).

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Table 8 : Bio efficacy of thiamethoxam against sugarcane whitefly - Saptur - third application

Treatment	Dose (g.ai./ha)	Pre count (mean/ 4cm^2 leaf area)	Percent reduction over control			
			1	3	7	14
Thiamethoxam 25 WG	25	94.22	18.33 (25.35)^f	48.67 (44.23)^e	57.41 (49.26)^f	31.01 (33.84)^f
Thiamethoxam 25 WG	50	93.01	21.47 (27.60)^e	53.01 (46.72)^d	64.01 (53.13)^d	40.32 (39.44)^d
Thiamethoxam 25 WG	100	93.13	26.66 (31.08)^c	76.33 (60.88)^b	88.73 (70.30)^b	47.03 (43.29)^c
Thiamethoxam 25 WG	200	91.38	27.80 (31.82)^b	78.01 (62.03)^a	90.33 (71.88)^a	51.57 (45.87)^b
Imidacloprid 200 SL	50	93.66	24.33 (29.55)^d	59.33 (50.37)^c	76.67 (61.11)^c	41.42 (44.60)^a
Dimethoate 30 EC	750	95.02	32.67 (34.86)^a	56.98 (48.26)^e	68.58 (62.94)^e	47.33 (43.01)^e
Untreated check	-	118.58	119.01*	119.61*	120.12*	120.67*

* Whitefly population in Untreated check
Means followed by a common letter are not significantly (p = 0.05) different by DMRT
Figures in parentheses are arcsine √ P; where P is the corrected per cent mortality
DAT: days after treatment

Table 9 : Cumulative effect of thiamethoxam against sugarcane whitefly – Saptur

Treatment	Dose (g.ai./ha)	Pre count (mean/ 4cm^2 leaf area)	Cumulative Percent reduction over control 14 DAT	
			II / I Spray	III / I Spray
Thiamethoxam 25 WG	25	109.98	31.79 (34.32)f	52.54 (46.45)f
Thiamethoxam 25 WG	50	118.83	36.41 (37.11)e	57.85 (49.51)e
Thiamethoxam 25 WG	100	119.44	49.08 (44.47)b	72.41 (58.31)b
Thiamethoxam 25 WG	200	111.93	52.36 (46.35)a	78.98 (62.71)a
Imidacloprid 200 SL	50	106.01	42.66 (40.78)d	63.05 (52.56)d
Dimethoate 30 EC	750	103.86	44.94 (42.09)c	68.21 (55.68)c
Untreated check	-	109.78	-	-

Means followed by a common letter are not significantly (p = 0.05) different by DMRT
Figures in parentheses are arcsine √ P; where P is the corrected per cent mortality
DAT: days after treatment

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