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Evaluation of insecticides for management of mango hopper, *Idioscopus niveosparsus* Leth

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Abstract
Mango hopper, (*Idioscopus niveosparsus* Leth) is an important pest of mango causing severe yield losses. Experiments were conducted at Regional Fruit Research Station, Vengurle to manage mango hopper on Alphonso variety with different insecticides alone and in combination with spreader during 2013-14 to 2016-17. Five different insecticides viz., buprofezin, spinosad, azadirachtin, acetamiprid and thiamethoxam were used alone and in combination with a spreader. From the pooled results, it is revealed that for management of mango hopper the treatment of thiamethoxam + spreader was found most effective (99.06%). Also, the same treatment recorded maximum yield (56.27 kg/tree).

Keywords: Mango hopper, *Idioscopus niveosparsus*, management, thiamethoxam

Introduction
Mango, *Mangifera indica* L. is an important fruit crop grown in Konkan region of Maharashtra and Alphonso is the major variety of this region. The mango crop is found to be infested by more than 100 insect pests [1], however, mango hopper is one of the most serious pests responsible for about 66 percent losses in fruit yield [2]. Three species of mango hoppers *viz. Amritodus atkinsoni, Idioscopus clypealis* and *I. niveosparsus* are commonly found all over India [3]. However, during recent years only *I. niveosparsus* is the most predominant species found in Konkan region of Maharashtra [4].

The adults of *Idioscopus niveosparsus* are 4 to 5 mm long, greenish grey coloured and wedge shaped with prominent triangular whitish band around the neck. The female hoppers lay eggs in the midrib of tender leaves on the under surface and at the time of panicle initiation the eggs are laid on the tender panicles. The incubation period is 3 to 5 days and nymphal period is 10 to 15 days. The pest intensity is severe during November to March. Both nymphs and adults suck cell sap from tender foliage, inflorescence and tender fruits. The tender leaves get twisted, the inflorescences become weak and shedding of flowers and tender fruits take place which badly affects the yield. In addition, hoppers excrete honey dew like substance on which black sooty mould (*Capnodium mangiferae*) grows which interferes with the photosynthetic activity of leaves and reduces the market value of fruits.

In order to manage the hopper incidence effectively, the experiments were conducted with five relatively newer insecticides alone and in combination with spreader at Regional Fruit Research Station, Vengurle during 2013-14, 2014-15 and 2016-17.

Material and methods
The management trials were conducted at Regional Fruit Research Station, Vengurle, M.S. during 2013-14, 2014-15 and 2016-17 on Alphonso variety. The experiments were laid out in Randomized Block Design with 11 treatments and 3 replications.

Treatment details
T_1 – Buprofezin 25 SC at 0.025% conc.
T_2 – Spinosad 45 SC at 0.015% conc.
T_3 – Azadirachtin 10000 PPM at 0.003% conc.
T_4 – Acetamiprid 20 SP at 0.002% conc.
T_5 – Thiamethoxam 25WG at 0.005% conc.
T_6 – Buprofezin 25 SC at 0.025% conc + spreader 0.5 ml/lit
T_7 – Spinosad 45 SC at 0.015% conc + spreader 0.5 ml/lit
T_8 – Azadirachtin 10000 PPM at 0.003% conc + spreader 0.5 ml/lit

T_9 – Acetamiprid 20 SP at 0.002% conc + spreader 0.5 ml/lit
T_{10} – Thiamethoxam 25WG at 0.005% conc + spreader 0.5 ml/lit
T_{11} – Control

No. of applications - Four
First Spray: At bud burst stage
Second Spray: 15 days after 1st spray.
Third Spray: 15 days after 2nd spray.
Forth Spray: 15 days after 3rd spray.

Observations on hopper population
Ten panicles were labeled randomly on each tree and the number of hoppers (nymphs and adults) observed on these panicles were counted. The pre-treatment observations were recorded 24 hrs before each spray and the post treatment observations were recorded 14 days after each spray.

Statistical analysis
Efficacy of different treatments against mango hopper was analysed by analysis of variance. The population data was corrected by the correction factor for determination of percent reduction (percent control) using the formula given by Henderson and Tilton [5].

$$\text{Percent reduction in population} = 100 \times \left(1 - \frac{T_a \times C_b}{T_b \times C_a} \right)$$

Where,
T_a = Number of insects in treatment after spray
T_b = Number of insects in treatment before spray
C_a = Number of insects in untreated check after spray
C_b = Number of insects in untreated check before spray

The data of percent reduction were transformed into arc sine values and subjected to analysis of variance. Also, the marketable fruit yield of respective treatment was recorded at the time of harvesting which was subjected to analysis of variance.

Results and discussion
The data on mean percent reduction in hopper population 14 days after spray recorded during 2013-14, 2014-15, 2016-17 and the pooled data is presented in Table 1. The data revealed that during all the three individual years, the treatment T_{10} (Thiamethoxam 25WG at 0.005% conc + spreader 0.5 ml/lit) recorded the maximum reduction in hopper population (99.59, 98.74 and 99.16%, respectively). However, it was at par with T_9 (Acetamiprid 20 SP at 0.002% conc + spreader 0.5 ml/lit), T_5 (Thiamethoxam 25WG at 0.005% conc.) and T_4 (Acetamiprid 20 SP at 0.002% conc.) during all the three years. The pooled data revealed that, the treatment T_{10} (Thiamethoxam 25WG at 0.005% conc + spreader 0.5 ml/lit) was most effective with a 99.06% reduction in hopper population, but it was at par with T_9 (Acetamiprid 20 SP at 0.002% conc + spreader 0.5 ml/lit) and T_5 (Thiamethoxam 25WG at 0.005% conc.).
From the yield data presented in Table 2, it is seen that the treatment T_{10} (Thiamethoxam 25WG at 0.005% conc. + spreader 0.5 ml/lit) has recorded maximum yield during all the three years (60.00, 53.23 and 55.57 kg/tree), however, it was at par with T_9 (Acetamiprid 20 SP at 0.002% conc. + spreader 0.5 ml/lit), T_5 (Thiamethoxam 25WG at 0.005% conc.), T_4 (Acetamiprid 20 SP at 0.002% conc.), T_7 (Spinosad 45 SC at 0.015% conc. + spreader 0.5 ml/lit), T_2 (Spinosad 45 SC at 0.015% conc.) and T_6 (Buprofezin 25 SC at 0.025% conc. + spreader 0.5 ml/lit) during 2013-14, whereas, during 2014-15 it was at par with T_9 (Acetamiprid 20 SP at 0.002% conc. + spreader 0.5 ml/lit), T_5 (Thiamethoxam 25WG at 0.005% conc.), T_7 (Spinosad 45 SC at 0.015% conc. + spreader 0.5 ml/lit) and T_2 (Spinosad 45 SC at 0.015% conc.). During 2016-17, the treatment T_{10} (Thiamethoxam 25WG at 0.005% conc. + spreader 0.5 ml/lit) was at par with T_9 (Acetamiprid 20 SP at 0.002% conc. + spreader 0.5 ml/lit), T_5 (Thiamethoxam 25WG at 0.005% conc.) and T_4 (Acetamiprid 20 SP at 0.002% conc.). Similarly the pooled data revealed that, the treatment T_{10} (Thiamethoxam 25WG at 0.005% conc. + spreader 0.5 ml/lit) recorded the maximum yield (56.27 kg/tree), however, it was at par with T_9 (Acetamiprid 20 SP at 0.002% conc. + spreader 0.5 ml/lit), T_5 (Thiamethoxam 25WG at 0.005% conc.) and T_4 (Acetamiprid 20 SP at 0.002% conc.).
These results are in close agreement with Patel [6], Kumar [7], Samanta [8], Anithakumari [9] and Ray [10] who reported thiamethoxam as an effective insecticide for management of mango hopper. Sharma [11] reported 91 percent reduction in hopper population in the treatment of thiamethoxam 10 days after application. Also, Thiruveni [12] reported that thiamethoxam 25 WG @ 37.5 and 50g a.i./ha significantly reduced the mango hopper population to an extent of 89.76 to 90.27 percent and 84.77 to 87.48 percent at two different locations, respectively. Also, Munj [13] reported that the module of three sprays (first spray of imidacloprid 17.8 SL @ 0.005% at panicle initiation stage, a second spray of quinalphos 25 EC @ 0.05% 21 days after first spray and third spray of thiamethoxam 25 WG @ 0.005% 15 days after second spray) was most effective with a 97.42 percent reduction in hopper population after last spray. Also, Samanta [7] reported that the treatment with 0.016 percent thiamethoxam was superior for management of mango hopper with higher yield (72 kg/tree).

Conclusion
From the overall results, it is concluded that, the insecticides thiamethoxam 25WG @ 0.005% and acetamiprid 20 SP @ 0.002% are most effective for management of mango hopper.

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Table 1: Cumulative efficacy of different treatments against mango hopper

T. No.	Treatments	Pre treatment population/ panicle	Cumulative mean reduction in hopper population (%) 14 days after spray			
			2013-14	2014-15	2016-17	Pooled Mean
T_1	Buprofezin 25 SC @ 0.05%	9.40 [3.21]*	92.43 (74.15)**	92.48 (74.24)**	92.40 (74.04)**	92.55 (74.31)**
T_2	Spinosad 45 SC @0.015%	8.73 [3.11]	92.48 (74.26)	91.54 (73.01)	92.31 (73.82)	91.98 (73.66)
T_3	Azadirachtin 10000 ppm @ 0.003%	9.27 [3.22]	68.89 (56.07)	60.54 (51.07)	64.71 (53.56)	64.81 (53.73)
T_4	Acetamiprid 20 SP @0.002%	9.77 [3.28]	97.30 (80.96)	97.24 (80.75)	97.27 (80.87)	97.37 (81.11)
T_5	Thiamethoxam 25 WG @0.005%	7.77 [2.96]	99.10 (84.67)	97.88 (81.69)	98.49 (83.02)	99.03 (84.44)
T_6	Buprofezin + Spreader (0.5ml/lit)	9.37 [3.20]	94.90 (76.75)	91.38 (73.04)	93.14 (74.84)	93.24 (74.81)
T_7	Spinosad + Spreader (0.5 ml/lit)	9.57 [3.24]	95.60 (77.96)	92.70 (74.32)	94.15 (76.18)	94.25 (76.34)
T_8	Azadirachtin + Spreader (0.5 ml/lit)	8.60 [3.10]	73.32 (58.92)	60.55 (51.16)	66.93 (54.95)	66.83 (55.04)
T_9	Acetamiprid + Spreader (0.5 ml/lit)	11.90 [3.66]	99.17 (85.18)	98.67 (83.49)	98.92 (83.96)	98.85 (84.08)
T_{10}	Thiamethoxam + Spreader (0.5 ml/lit)	9.10 [3.17]	99.59 (86.41)	98.74 (83.57)	99.16 (84.92)	99.06 (84.59)
T_{11}	Control	8.90 [3.14]	-	-	-	-
	S.E.m ±	0.15	2.58	2.29	1.89	0.64
	C. D. at 5%	N.S.	7.32	6.66	5.62	1.90

* Figure in parenthesis are square root transformed values

** Figure in parenthesis are arc sine transformed values

Table 2: Yield data recorded in different treatments

T. No.	Treatments	Yield (kg/tree)			
		2013-14	2014-15	2016-17	Pooled Mean
T_1	Buprofezin 25 SC @ 0.05%	49.67	41.47	41.67	44.27
T_2	Spinosad 45 SC @0.015%	51.20	56.57	40.77	46.18
T_3	Azadirachtin 10000 ppm @ 0.003%	42.33	35.13	31.77	36.41
T_4	Acetamiprid 20 SP @0.002%	58.10	50.70	52.13	53.64
T_5	Thiamethoxam 25 WG @0.005%	57.60	51.30	53.17	54.02
T_6	Buprofezin + Spreader (0.5ml/lit)	51.00	41.50	40.73	44.41
T_7	Spinosad + Spreader (0.5 ml/lit)	54.90	46.63	41.27	47.60
T_8	Azadirachtin + Spreader (0.5 ml/lit)	46.03	36.77	32.90	38.57
T_9	Acetamiprid + Spreader (0.5 ml/lit)	58.47	50.90	52.60	53.99
T_{10}	Thiamethoxam + Spreader (0.5 ml/lit)	60.00	53.23	55.57	56.27
T_{11}	Control	29.70	25.73	23.77	26.40
	S.E.m ±	3.20	3.07	2.39	1.13
	C. D. at 5%	9.45	9.07	7.06	3.34

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