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V Manimaran
Department of Silviculture and Natural Resource Management, Forest College and Research Institute, Mettupalayam, Tamil Nadu, India

M Suganthy
Department of Silviculture and Natural Resource Management, Forest College and Research Institute, Mettupalayam, Tamil Nadu, India

A Balasubramanian
Department of Silviculture and Natural Resource Management, Forest College and Research Institute, Mettupalayam, Tamil Nadu, India

P Pretheep Kumar
Department of Forest Products and Wildlife, Forest College and Research Institute, Mettupalayam, Tamil Nadu, India

Correspondence
M Suganthy
Department of Silviculture and Natural Resource Management, Forest College and Research Institute, Mettupalayam, Tamil Nadu, India

Management of tea mosquito bug, *Helopeltis antonii* Signoret infesting *Ailanthus excelsa* Roxb

V Manimaran, M Suganthy, A Balasubramanian and P Pretheep Kumar

Abstract

Ailanthus excelsa is a multipurpose, fast growing tree species belongs to the family Simaroubaceae. Severe infestation of *Helopeltis antonii* Signoret causing drying and death of terminal shoots and forking was documented in two years old plantations of *A. excelsa* at Forest College and Research Institute (FC&RI), Mettupalayam from November, 2018 to February, 2019. Results of field experiment conducted to test the efficacy of chemical pesticides against tea mosquito bug (TMB) revealed that at 14 days after treatment (DAT), the reduction in TMB population over untreated control was recorded to be 96.30 per cent in thiacloprid treatment, as against 62.96 per cent in dichlorvos treatment. Mean number of TMB per tree after 14 DAT was observed to be 0.05 per tree in thiacloprid treatment as against 7.40 bugs per tree in untreated control. All the treatments have recorded more than 90 per cent reduction in TMB population except chlorpyriphos which has registered 88.12 per cent reduction over a period of 14 days of treatment. Results of field experiment conducted to test the efficacy of bio-pesticides against TMB revealed that mean number of tea mosquito bugs recorded per tree over a period of 14 days of treatment was minimum (1.53 per tree) in azadirachtin 10,000 ppm treated trees followed by NSKE 5 per cent (1.93 per tree) treatment. Among the three microbials tested, *Beauveria bassiana* recorded the minimum bug population of 3.47 per tree, as against 3.93 bugs per tree in *Metarhizium anisopliae* treatment. The mean per cent reduction over control was observed to be 77.66 and 72.13 per cent in azadirachtin and NSKE 5 per cent treatments, respectively, while, the standard chemical check profenophos registered 93.40 per cent reduction over untreated control.

Keywords: *Helopeltis antonii, Ailanthus excelsa,* chemical pesticides, bio-pesticides, management

Introduction

Ailanthus excelsa Roxb. is a multipurpose, deciduous, fast growing tree species belongs to the family Simaroubaceae. It grows well in arid and semi-arid regions and is suitable for planting in dry areas with annual rainfall of about 400 mm. It avoids moist areas having high rainfall. It grows in broad range of soil types including sandy soils, adapts to drought stress and tolerates a dry season of 4 to 6 months. With respect to Tamil Nadu, *A. excelsa* is widely distributed in four agro climatic zones *viz.,* Western zone, North Western zone, Cauvery delta zone and Southern zone (Rajasugunasekar, 2014) [1]. Because of land degradation and unavailability of intensive agricultural system, *A. excelsa* became an important agroforestry tree species and popularized under social forestry system. The demand for *A. excelsa* is increasing during recent years due to its multipurpose uses. Owing to such importance as multipurpose tree, it is a matter of concern to keep these trees healthy from the damages caused by arthropods pests.

All the parts of the tree *viz.,* foliage, shoots, stem, terminal leaders and roots are vulnerable to pest infestation. The damage due to arthropod pests ranges from minimum of less than 10 per cent which has no effect on the value of the harvested produce to severe that stunts or kills the tree or reduces the market value. Mirid bugs of genus *Helopeltis* are serious pests of various cultivated plants in the Old World Tropics. The damaging effect of these insects on tea plants in India was documented over a century ago. It was in these early accounts that the common names 'tea bug' and 'tea mosquito' were established. Since the late 1800's, over 100 species of plants have been reported as hosts for *Helopeltis* spp. including a number of major commercial crops such as cashew, black pepper, cocoa, cinchona and tea. Of the 40 recognized species of *Helopeltis*, 26 are restricted to Africa and 14 are distributed in Oriental and Australasian regions (Stonedahl, 1991) [5]. In South India, earlier records indicated the occurrence of two species of *Helopeltis*, *viz.*, *H. antonii* Signoret and *H. theivora* Waterhouse (Fletcher, 1914; Ballard, 1921) [2, 3]. Later, three species of tea mosquito bug (TMB), *viz. H. antonii* Signoret, *H. bradyi* Waterhouse and *H. theivora* Waterhouse were recorded (De Silva, (De Silva, 1957; Stonedahl, 1991; Sundararaju, 1996) [4-6]. Among them, *H. antonii* was recorded as the dominant species (Sundararaju and Bakthavatsalam, 1994; Sundararaju, 1996) [7, 6]. Satapathy (1993) [8] and Sundararaju (1996) [6] reported the incidence of tea mosquito bug, *H. antonii* in *Ailanthus* spp.


Helopeltis antonii


Infestation in terminal shoot


Dryinng of terminal shoot

Pest management strategies are to be designed to have long-term prevention of pests and their damage. Severe damage due to tea mosquito bugs in *A. excelsa* warrants an effective management strategy. Chemical pesticides are to be auspicious but for the concern of natural enemies and environment, botanicals and microbial pesticides are considered as promising methods to manage the pests without any secondary response. Pest management in tree crops should be based on thorough consideration of ecological and economic factors. Pest, its biology, type and extent of damage are some of the factors that determine the management strategies to be followed. Ultimately the pest management decisions in tree crops represent a compromise between the value of the product, the extent of damage, cost of management measures, relative efficacy and the impact on the environment. With this background, the present study was undertaken on the management of tea mosquito bug, *H. antonii* using chemical and biopesticides.

Materials and Methods

Field experiments were carried out in the Precision Silviculture Farm, Department of Silviculture and Natural Resource Management, Forest College and Research Institute, Mettupalayam during 2018-2019 to assess the field efficacy of selected chemical and biopesticides against tea mosquito bug, *H. antonii* the emerging sucking pest causing extensive damage to the terminal shoots of *A. excelsa*. Incidence of tea mosquito bug was severe (more than 10 per cent damage to the terminal shoots) during second fortnight of November, 2018.

Studies on the efficacy of chemical pesticides against *Helopeltis antonii*

Field experiment was conducted to test the efficacy of chemical pesticides against tea mosquito bug, *H. antonii* with the following six treatments replicated four times under randomized block design. Pre-treatment count on tea mosquito bug population was made before spraying. Post-treatment counts were taken at one, three, five, seven and fourteen days after spraying. Five trees were selected from each replication and the pest population was recorded from top 15 cm terminal shoot and expressed as number per tree.

T_1 - Chlorpyriphos 20 EC @ 2 ml/l
T_2 - Dichlorvos 76 EC @ 2 ml/l
T_3 - Quinalphos 25 EC @ 2 ml/ l
T_4 - Profenophos 50 EC @ 2 ml/l
T_5 - Thiacloprid 240 SC @ 1.5 ml/l
T_6 - Untreated control

Studies on the efficacy of biopesticides against *Helopeltis antonii*

Field experiment was conducted to study the efficacy of biopesticides against tea mosquito bug, *H. antonii* with the following seven treatments replicated thrice under randomized block design (RBD). Pre-treatment count on tea mosquito bug population was made before spraying. Post-treatment counts were taken at one, three, five, seven and fourteen days after spraying. Five trees were selected from each replication and the pest population was recorded from top 15 cm terminal shoot and expressed as number per tree. Profenophos 50 EC was used as standard chemical check for comparison, besides having an untreated check.

T_1 - Azadirachtin 10,000 ppm @ 1 ml/l
T_2 - NSKE 5%
T_3 - *Beauveria bassiana* @ 5 g/l
T_4 - *Bacillus thuringiensis* @ 5 g/l
T_5 - *Metarhizium anisopliae* @ 5 g/l
T_6 - Profenophos 50 EC @ 2 ml/l (Chemical check)
T_7 - Untreated control

The data from field observations were analyzed following the procedure described by Panse and Sukatme (1969) [9]. Wherever necessary, the pest load in number was transformed into square root of x + 0.5 values and percentage into arc sine values before carrying out statistical analysis.

Results and Discussion

Efficacy of chemical pesticides against *Helopeltis antonii* infesting *Ailanthus excelsa*

Results of field experiment conducted to test the efficacy of chemical pesticides against tea mosquito bug (TMB), *H. antonii* during 2018-2019 revealed that pre-treatment count of tea mosquito bugs was in the range of 4.25 to 5.50 TMB per tree. At 1 DAT, the population of TMB was observed to be nil in thiacloprid treated trees, followed by profenophos treatment with the population of 0.25 per tree. Dichlorvos, quinalphos and chlorpyriphos were next in the order of efficacy with the population of 0.50, 0.75 and 1.25 TMB per tree, respectively, as against the maximum population of 9.50 per tree in the untreated control. At 1 DAT, reduction in TMB population over control was recorded to be cent per cent in thiacloprid treatment, followed by 97.37, 94.74, 92.11 and 86.84 per cent in profenophos, quinalphos, chlorpyriphos and dichlorvos treatments, respectively. At 3 DAT, the population of TMB was observed to be nil in thiacloprid, profenophos and chlorpyriphos treatments as against 6.75 per tree in untreated control.

At 3 DAT, profenophos, thiacloprid and chlorpyriphos have recorded cent per cent reduction in TMB population over untreated control. At 5 DAT, the population of TMB was observed to be nil in all the treatment and have recorded cent per cent reduction in the TMB population over untreated control. At 7 DAT, the population of TMB was observed to be nil in profenophos and thiacloprid treated trees, followed by dichlorvos, quinalphos and chlorpyriphos treatments with the population of 0.25, 0.50 and 1.00 per tree and showed cent per cent reduction in TMB population over control in thiacloprid and profenophos treatments. Even at 14 DAT, thiacloprid and profenophos recorded superiority with the population of 0.25 and 0.50 TMB per tree. Quinalphos (1.75/tree), chlorpyriphos (2.25/tree) and dichlorvos (2.50/tree) were recorded to be next in the order of efficacy and were found to be on par with each other, as against the maximum population of 6.75 TMB per tree in the untreated tree. At 14 DAT, the reduction in TMB population over control was recorded to be 96.30 per cent in thiacloprid treatment, as against 62.96 per cent in dichlorvos treatment. Mean number of TMB per tree after 14 DAT was observed to be 0.05 per tree in thiacloprid treatment as against 7.40 TMB per tree in untreated control. All the treatments have recorded more than 90 per cent reduction in TMB population except chlorpyriphos which has registered 88.12 per cent reduction over a period of 14 DAT (Table 1). The results on the efficacy of thiacloprid on tea mosquito bug are in line with the findings of Srinivasnaik (2015) [10] in cocoa. Systemic nature of chemical pesticides evaluated resulted in more than 90 per cent reduction in TMB population over untreated control.

Efficacy of biopesticides against *Helopeltis antonii* infesting *Ailanthus excelsa*

Results of field experiments conducted to test the efficacy of biopesticides against tea mosquito bug, *H. antonii* during 2018-2019 revealed that population of TMB was in the range of 3.95 to 4.75 during pre-treatment count and was recorded to be statistically non-significant. At 1 DAT, the population of TMB was observed to be nil in profenophos treated tree as against 6.33 per tree in the untreated control. Among the biopesticides tested, azadirachtin 10,000 ppm treated trees recorded minimum population (3.00) and was found to be on par with NSKE 5 per cent treatment. *Bacillus thuringiensis* (4.00), *Beauveria bassiana* (4.33) and *Metarhizium anisopliae* (4.67) were found to be statistically on par with each other in their efficacy. At 1 DAT, per cent reduction over untreated control was recorded to be minimum in *M. anisopliae* (26.22) treated trees as against 52.61 per cent in azadirachtin treatment.

Similar trend was observed at 3 DAT with 2.00 bugs per tree in azadirachtin treated trees, as against 6.67 bugs in untreated control. At 5 DAT, the efficacy of azadirachtin treatment (1.00 bug/tree) was recorded to be on par with chemical check. NSKE 5 per cent (1.33) and *B. thuringiensis* (3.33) were next in the order of efficacy and were found to be statistically on par. At 7 DAT, azadirachtin 10,000 ppm recorded superiority with the lowest bug population of 0.67 per tree and NSKE 5 per cent (1.00) was recorded to be on par, as against 6.33 bugs per tree in untreated control. At 14 DAT also azadirachtin (1.00) was recorded to be superior, while *B. thuringiensis* registered maximum of 4.33 bugs, as against 8.33 bugs in untreated control. As the days after treatment progressed, the efficacy of biopesticides also increased with the maximum reduction of 87.99 per cent in azadirachtin treatment as against 48.02 per cent reduction in *B. thuringiensis* treatment at 14 DAT.

Mean number of tea mosquito bugs recorded per tree over a period of 14 days of treatment was minimum (1.53 per tree) in azadirachtin treatment followed by NSKE 5 per cent (1.93 per tree). Among the three microbials tested, *B. bassiana* recorded the minimum bug population of 3.47 per tree, as against 3.93 bugs per tree in *M. anisopliae* treatment. The mean per cent reduction over control was observed to be 77.66 and 72.13 per cent in azadirachtin and NSKE 5 per cent treatments, respectively, followed by 49.09 per cent reduction in *B. bassiana* treatment. *M. anisopliae* treatment recorded only 42.40 per cent reduction in TMB population over untreated control, while the standard chemical check profenophos registered 93.40 per cent reduction over control (Table 2).

Similar results were reported by Ayenor *et al.* (2007) [11] who observed cent per cent mortality of cocoa capsids in cages and 79 to 88 per cent in field after 48 hours of treatment with 20 per cent aqueous neem seed extract. Dutta *et al*. (2013) [12] also reported that aqueous extract of neem seed kernel at 5 per cent concentration was found to be effective against tea mosquito bug, *H. theivora* in the laboratory conditions in terms of antifeedant activity, hatching percentage, oviposition period and nymphal duration.

Results of present investigation on the efficacy of thiacloprid and azadirachtin 10,000 ppm in the management of tea mosquito bugs are in accordance with the findings of Srinivasnaik (2015) [10], who has reported that IPM module in cocoa comprising of proper pruning, clean cultivation, erection of yellow sticky light traps @10 per ha, foliar application of *Beauveria bassiana* ($2x10^8$ cfu / ml) @ 5 kg per ha coinciding with the population build up of tea mosquito bugs, foliar application of azadirachtin 10,000 ppm @ 500 ml per ha coinciding with peak flowering and foliar application of thiacloprid 21.7 % SC @ 750 ml per ha during pod formation stage was significantly superior over the farmer's practice in checking the tea mosquito bug population.

Table 1: Efficacy of chemical pesticides against tea mosquito bug, *Helopeltis antonii* during 2018-2019 at FC&RI, Mettupalayam

S. No.	Treatments	Number of tea mosquito bugs/tree*							Per cent reduction over control					
		PTC	1 DAT	3 DAT	5 DAT	7 DAT	14 DAT	Mean	1 DAT	3 DAT	5 DAT	7 DAT	14 DAT	Mean
1	Chlorpyriphos 20 EC	4.50	1.25^{b} (1.32)	0.00^{a} (0.71)	0.00^{a} (0.71)	1.00^{b} (1.22)	2.25^{b} (2.00)	0.90	86.84	100.00	100.00	87.10	66.67	88.12
2	Dichlorvos 76 EC	4.75	0.50^{ab} (1.00)	0.25^{a} (0.87)	0.00^{a} (0.71)	0.25^{ab} (0.87)	2.50^{b} (1.73)	0.70	94.74	96.30	100.00	96.77	62.96	90.15
3	Quinalphos 25 EC	5.00	0.75^{ab} (1.12)	0.25^{a} (0.87)	0.00^{a} (0.71)	0.50^{ab} (1.00)	1.75^{b} (1.50)	0.65	92.11	96.30	100.00	93.55	74.07	91.21
4	Profenophos 50 EC	5.25	0.25^{a} (0.87)	0.00^{a} (0.71)	0.00^{a} (0.71)	0.00^{a} (0.71)	0.50^{a} (1.00)	0.15	97.37	100.00	100.00	100.00	92.59	97.99
5	Thiacloprid 240 SC	4.25	0.00^{a} (0.71)	0.00^{a} (0.71)	0.00^{a} (0.71)	0.00^{a} (0.71)	0.25^{a} (0.87)	0.05	100.00	100.00	100.00	100.00	96.30	99.26
6	Untreated control	5.50	9.50^{c} (3.16)	6.75^{b} (2.69)	6.25^{b} (2.59)	7.75^{c} (2.87)	6.75^{c} (3.09)	7.40	-	-	-	-	-	-
	S. Ed	-	0.22	0.13	0.12	0.17	0.15	-	-	-	-	-	-	-
	CD (P=0.05)	NS	0.47	0.28	0.26	0.35	0.31	-	-	-	-	-	-	-

PTC - Pre treatment count; DAT - Days after treatment; NS - Non significant; *Mean of 3 replications
In a column, means followed by common letter(s) are not significantly different by LSD
Figures in parenthesis are square root transformed values

Table 2: Efficacy of biopesticides against tea mosquito bug, *Helopeltis antonii* during 2018-2019 at FC&RI, Mettupalayam

S. No	Treatments	Number of tea mosquito bugs/ tree*							Per cent reduction over control					
		PTC	1 DAT	3 DAT	5 DAT	7 DAT	14 DAT	Mean	1 DAT	3 DAT	5 DAT	7 DAT	14 DAT	Mean
1	Azadirachtin 10,000 ppm	4.00	3.00^{b} (1.87)	2.00^{b} (1.58)	1.00^{a} (1.22)	0.67^{a} (1.08)	1.00^{ab} (1.22)	1.53	52.61	70.01	88.00	89.41	87.99	77.66
2	NSKE 5%	4.00	3.33^{b} (1.96)	2.33^{b} (1.68)	1.33^{ab} (1.35)	1.00^{a} (1.22)	1.67^{bc} (1.47)	1.93	47.39	65.07	84.03	84.20	79.95	72.13
3	*Beauveria bassiana*	4.67	4.33^{bc} (2.20)	4.33^{bc} (2.20)	3.67^{c} (2.04)	2.67^{ab} (1.78)	2.33^{cd} (1.68)	3.47	31.60	35.08	55.94	57.82	72.03	50.59
4	*Bacillus thuringiensis*	3.95	4.00^{bc} (2.12)	3.67^{b} (2.04)	3.33^{bc} (1.96)	2.67^{ab} (1.78)	4.33^{e} (2.20)	3.60	36.81	44.98	57.82	57.82	48.02	49.09
5	*Metarhizium anisopliae*	4.67	4.67^{bc} (2.27)	4.33^{bc} (2.20)	3.67^{c} (2.04)	3.33^{bc} (1.96)	3.67^{de} (2.04)	3.93	26.22	35.08	47.39	47.39	55.94	42.40
6	Profenophos 50 EC (Chemical check)	4.33	0.00^{a} (0.71)	0.00^{a} (0.71)	0.00^{a} (0.71)	1.33^{ab} (1.35)	1.00^{a} (1.22)	0.27	100.00	100.00	100.00	78.99	87.99	93.40
7	Untreated control	4.75	6.33^{c} (2.61)	6.67^{c} (2.68)	8.33^{d} (2.97)	6.33^{c} (2.61)	8.33^{f} (2.97)	7.20	-	-	-	-	-	-
	S. Ed	-	0.27	0.29	0.33	0.35	0.22	-	-	-	-	-	-	-
	CD (P=0.05)	NS	0.60	0.63	0.72	0.76	0.48	-	-	-	-	-	-	-

PTC - Pre treatment count; DAT - Days after treatment; NS - Non significant; *Mean of 3 replications
In a column, means followed by common letter(s) are not significantly different by LSD
Figures in parenthesis are square root transformed values

Conclusion

Considering the importance of *Ailanthus excelsa* as a multi-purpose agroforestry tree species fetching remuneration to the farmers in the marginal lands, plantations up to two years old need to be protected from this devastating pest. Hence, from the results of above field experiments, foliar application of azadirachtin 10,000 ppm @ 1 ml/litre or neem seed kernel extract 5 per cent is recommended as an effective biopesticides for the management of tea mosquito bugs infesting *A. excelsa*. As a last resort, when the damage caused by tea mosquito bugs exceeds 10 per cent to the terminal shoot, foliar application of either thiacloprid 240 SC @ 1.5 ml/litre or profenophos 50 EC @ 2 ml/litre is recommended to have maximum reduction in the population of tea mosquito bugs infesting *A. excelsa*.

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