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Research Article

Impact of insecticides on mango pests and their natural enemies

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ABSTRACT: Impact of insecticides on mango pests and their natural enemies was studied at College of Agriculture, Vellayani and Padannakkad during 2015-16. Observations were recorded on pest and Natural Enemies (NEs) population at fortnightly intervals. Management studies were carried out in RBD and observations were recorded before and after spraying on 1,3,5,7,9,10 and 15 days. It was observed that NEs population was closely associated with the occurrence of pest population and found peak incidence during March-2015. Chlorantraniliprole 0.03% SC and flubendiamide 0.01% SC were found to be best treatments by reducing 82.41 and 74.60 per cent larvae/web respectively. Imidacloprid 0.005% and thiamethoxam 0.005% found to be better treatment with 90.64 and 87.40 per cent reduction of leaf hoppers respectively. But they had equally reduced the NEs population. Azadirachtin 1% and *Beauveria bassiana* 2% found to record highest number of NEs with moderate efficacy against the target pests.

KEYWORDS: Chlorantraniliprole, flubendiamide, natural enemies, Padannakkad, Vellayani

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INTRODUCTION

Mango (*Mangifera indica* L.) is the most important subtropical fruit crop of India, it is considered as the 'King of Fruits'. The fruits are utilized at all stages of development *i.e.*, from immature stage to mature stage and during this period fruits are attacked by several insect-pests (Kumar *et al*., 2005). The pests include leaf hopper, mealy bug, inflorescence midge, fruit fly, scale insects; shoot borer, leaf webber and stone weevil, causing considerable crop damage (Hati *et al*., 2005). India accounts for 41 per cent of the world production of mango (Chakrabarti, 2014). To tackle the problem of pests infesting mango, conventional and third generation insecticides are being used by the mango growers. Conventional insecticides and pyrethroids, due to their disadvantages, are being replaced by new molecules in the present-day market. The broad-spectrum activity of these new molecules at low dosages, coupled with low mammalian toxicity and safety to non-target organisms made them an alternative to conventional insecticides (Kumar, 2006). Overuse of non- selective pesticides in agriculture has several important adverse effects, of which harm caused to bio-control agents is the most relevant (Carmo *et al*., 2010). The adverse effect on biocontrol agents usually results in pest resurgence and occurrence of secondary pests (Fernades *et al.,* 2010). To mitigate these problems comprehensive studies, need to be carried out on use of selective pesticides, which are compatible to non target organisms and for sustainable insect pest management in mango. In the present study different insecticides were tested to control mango hoppers and leaf webber and their impact on natural enemies was studied.

MATERIALS AND METHODS

The present investigation was conducted during the year 2015-16 at Instructional Farm, Vellayani, Kalliyoor, Thiruvananthapuram and College of Agriculture, Padannakkad, Kasaragod, Kerala. Observations were recorded on the total webs in individual trees by counting visually the number of webs formed in a tree by mango leaf webber. This was done by dividing the whole canopy of the tree into four quadrants according to four cardinal directions *i.e.,* East, West, North and South (Kannan and Rao, 2006; NICRA, 2012; Singh and Verma, 2013). For mango hoppers sweep net counts and covering the panicle with polythene bags of size 60 × 30 cm were used (Verghese and Rao, 1987; Manjunatha, 2015; NICRA, 2012). Populations of NEs were also recorded by visual counting and sweep net. Field experiment was carried out in Randomized Block Design (RBD) to evaluate the efficacy of insecticides against leaf webber and leaf hoppers and their impact on natural enemies. Treatments include conventional insecticides, new molecules, botanical and microbial pesticides. Observations were recorded on pre-count just before the application of treatments and after the application of treatments at 1, 3, 5, 7, 10 and 15 days. The treatments emamectin benzoate 5 SG (0.002%), spinosad 5 SC (0.015%), lambdacyhalothrin 5 EC (0.005%), flubendiamide 39.5 SC (0.01%), chlorantraniliprole 18.5 SC (0.03%), indoxacarb 15.8 EC (0.02%), malathion 50 EC (0.1%), azadirachtin 1% EC, *Beauveria bassiana* (ITCC 6063) WP 2%, water spray and control included for the management of mango leaf webber. Lambdacyhalothrin 5 EC (0.005%), thiamethoxam 25 WG (0.005%), deltamethrin 2.8 EC (0.05%), imidacloprid 17.8 SC (0.005%), dimethoate 30 EC (0.05%), malathion 50 EC (0.1%), azadirachtin 1% EC, *B. bassiana* (ITCC 6063) WP 2%, water spray and untreated were imposed for the management of the leaf hoppers.

Percentage reduction of pest population and their natural enemies

After the application of the treatments, reduction of pest population over control was worked out using Handerson-Tilton's formula (Adnan *et al.,* 2014).

$$[1 - \frac{Ta}{Ca} \times \frac{Cb}{Tb}] \times 100$$

T_a – Infestation in treated trees after treatment

T_b – Infestation in treated trees before treatment

C_a – Infestation in control trees after treatment

C_b – Infestation in control trees before treatment

RESULTS AND DISCUSSION

During this study period many insect pests of mango were recorded, and mango hoppers were identified as *Amritodus* sp., *Idioscopus nitidulus* Walker, *I. clypealis* Letheirry and *I. nagpurensis.* Leaf webber was identified as *Orthaga exvinacea* Hampson. Predatory spiders were identified as *Oxyopes javanus* Thorell, *Argiope pulchella* Thorell, *Tetrognatha* sp., unidentified reduviid bugs, praying mantis and greenlace wing were the different NEs recorded.

Population of NEs was recorded for one year. The population of NEs seen peak in March, *i.e.*, 13.5/plant and minimum in July (4.6/plant). The number of NEs was found to be in the range of 8-10/plant during the rest part of the observation period (Fig. 1). It is clear from the Fig. 1 and Table 1 that, the NEs population was closely associated with the mango pest population throughout the observation period.

Table 1. Occurrence of mango pests from Jan-2015 to Dec-2015

Name of pest	Affected part	Stage of damage	Period of Damage					
			Jan-Feb	Mar-April	May-June	July-August	Sept-Oct	Nov-Dec
Mealy bugs	All parts	Nymphs and adults	+	++	–	–	+	+
Scales	Leaf, fruit inflo-rescence	Nymphs and adults	+	++	–	–	+	+
Leaf miner	Leaf	Grub	++	+	+	_	_	+
Leaf gall midge	Leaf	Adult	+	++	+	_	+	+
Shoot borer	Terminal shoots	Caterpillar	+	+	_	_	++	+
Leaf twisting weevil	Leaf	Adult and grubs	+	–	–	–	+	++
Ash weevil	Leaf	Adults	++	+	-	-	+	+
Leaf cutting weevil	Young leaves and shoots	Adults	+	+	–	–	–	++
Leaf eating caterpillar	Young Leaves	Caterpillar	++	+	–	–	–	+
Mango hairy caterpillar	Leaf	Caterpillar	+	–	–	–	–	+
Cowbugs	Terminal shoot	Nymphs and adults	+	++	–	–	–	–
Inflorescence caterpillar	Inflorescence	Caterpillar	++	+	–	–	–	+
Fruit fly	Fruit	Adult and maggot	_	+	+	+	_	_
Black fly	Leaf	Nymphs and adults	+	+	–	–	+	+

'++' maximum population, '+' minimum population and '_' no population

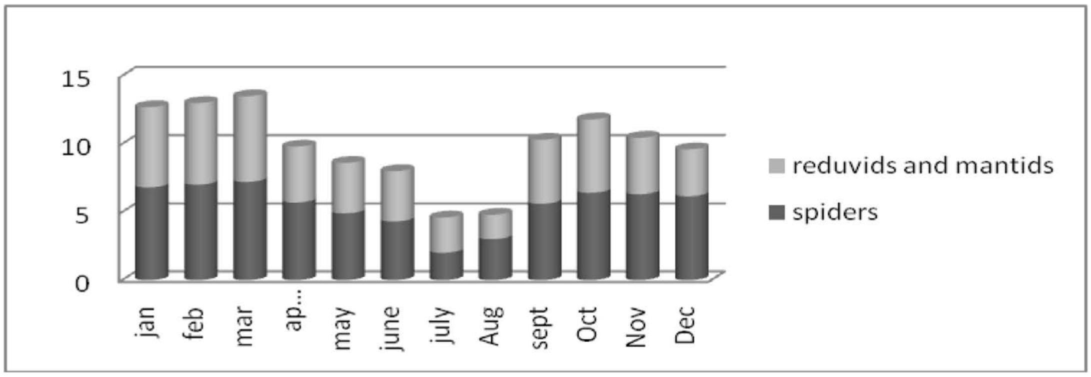

Fig. 1. Association of natural enemies in mango ecosystem during Jan 2015 to Dec 2015.

Management of leaf webber and leaf hopper of mango

Management studies of leaf webber studies revealed that at 15 DAS, chlorantraniliprole 0.03 per cent gave the superior result in controlling the pest incidence with 78.96 and 82.41 per cent (Fig. 2) reduction in the webs tree^{-1} and larvae web^{-1}, respectively. This was followed by flubendiamide 0.01 per cent which reduced 72.16 per cent and 74.60 per cent of webs tree^{-1} and larvae web^{-1}, respectively. Similar findings were reported by Masanori *et al.* (2005) where they confirmed the highest efficacy of flubendiamide as a novel insecticide and very effective chemical against lepidopteran insects which is in agreement with the present findings.

The descending order of efficacy of the remaining treatments was lambdacyhalothrin 0.005 per cent > indoxacarb 0.02 per cent > *B. bassiana* (ITCC 6063) WP 2 per cent > emamectin benzoate 0.002 per cent > azadirachtin 1 per cent > malathion 0.1 per cent > spinosad 0.015 per cent (Fig. 2).

Management studies of mango hoppers showed that, among the treatments imidacloprid 0.005 per cent showed the highest efficacy over the control. At 15 DAS this chemical recorded 81.27, 93.43 and 97.22 per cent reduction of hoppers sweep net^{-1}, hoppers panicle^{-1} and hoppers shoot^{-1}, respectively. It was followed by thiamethoxam 0.005 per cent. Here the reduction of hopper population over the control was 77.86, 87.45 and 96.90 per cent of hoppers sweep net^{-1}, hoppers panicle^{-1} and hoppers shoot^{-1}, respectively. Similar findings were reported by Anithakumari *et al.* (2009) and Samanta *et al.*(2009) which also showed that thiamethoxam was recorded as the second-best treatment after imidacloprid.

Lambda-cyhalothrin 0.005 per cent (72.70, 79.92 and 88.07 per cent hoppers sweep net^{-1}, hoppers panicle^{-1} and hoppers shoot^{-1}, respectively), dimethoate 0.05 per cent (70.65, 74.01 and 79.80 per cent hoppers sweep net^{-1}, hoppers panicle^{-1} and hoppers shoot^{-1}, respectively), deltamethrin 0.05 per cent (68.98, 73.58 and 79.12 per cent hoppers sweep net^{-1}, hoppers panicle^{-1} and hoppers shoot^{-1}, respectively), *B. bassiana* (ITCC 6063) 2 per cent and azadirachtin 1 per cent were ranked as the next best treatments. Malathion 0.1 per cent recorded the least efficacy by reducing only 60.81, 65.48 and 68.16 per cent hoppers sweep net^{-1}, hoppers panicle^{-1} and hoppers shoot^{-1}, respectively (Fig. 3).

The treatments used to manage the mango pest have shown their effect and apart from that it was observed for impact on natural enemies of mango pest. From the Fig. 4 it is clear that the azadirachtin 1% treated plants have shown least reduction of NEs (22.49 %) followed by *B. bassiana* 2% (29.55%), emamectin benzoate 0.002% (38.84%), indoxacarb 0.02% (44.53%), spinosad 0.015% (47.84%), chlorantraniliprole 0.03% (52.67%), flubendiamide 0.01% (53.09%), imidacloprid 0.005% (53.59%) malathion (56.08%), thiamethoxam 0.005% (58.85%), dimethoate 0.05% (63.79%), lambdacyhalothrin 0.005% (66.41%) and highest reduction in deltamethrin 0.05% treated plants (69.37%).

The treatments which showed significant control of the pest did equal damage in reducing the NEs population. In case of webber management chlorantraniliprole 0.03% and flubendiamide 0.01% were recorded as the best treatments to control the leaf webber but same treatments were able to reduce the NEs number considerably indicating their adverse effects on non - target organism also. In case of mango hopper management imidacloprid 0.005% and thiamethoxam 0.005% found to be best treatments to control the pest but also reduced the number of NEs. Azadirachtin 1% and *B. bassiana* which showed moderate control of the pests and had much less less impact on the NEs population. The results are in agreement with findings of Adnan *et al.* (2014) in which neem oil was having less effect on NEs population but able to control the mango hoppers moderately. Rest of treatments had moderate control of pest and equally reducing the number

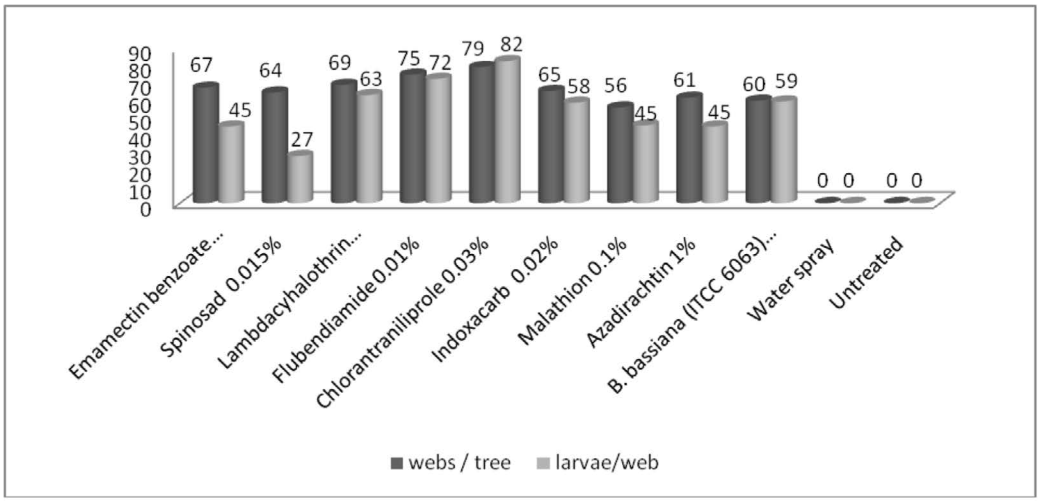

Fig. 2. Percentage reduction of mango leaf webber *Orthaga exvinacea.*

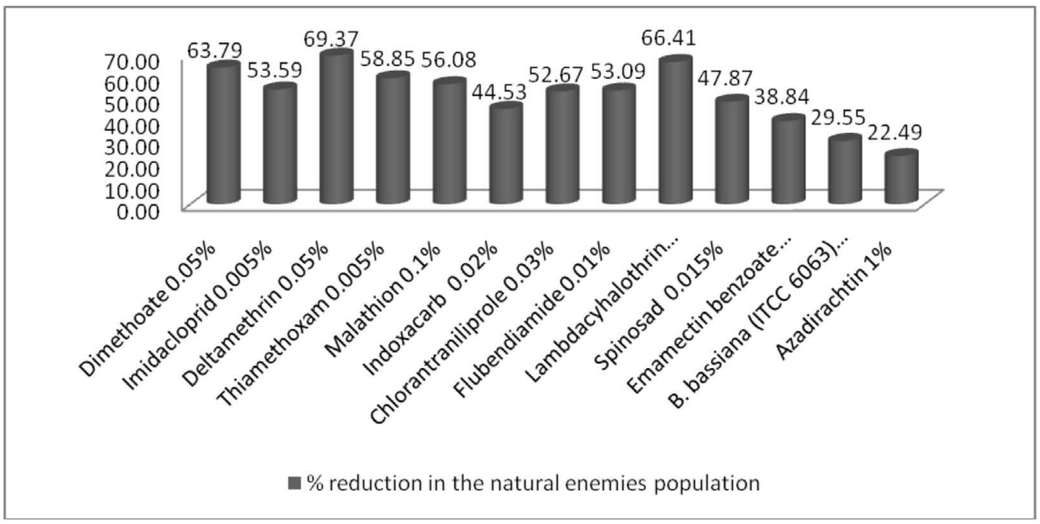

Fig. 3. Percentage reduction of mango hoppers (*Amritodes* spp., *Idioscopus clypealis, I. nitidulus and I. nagpurensis*).

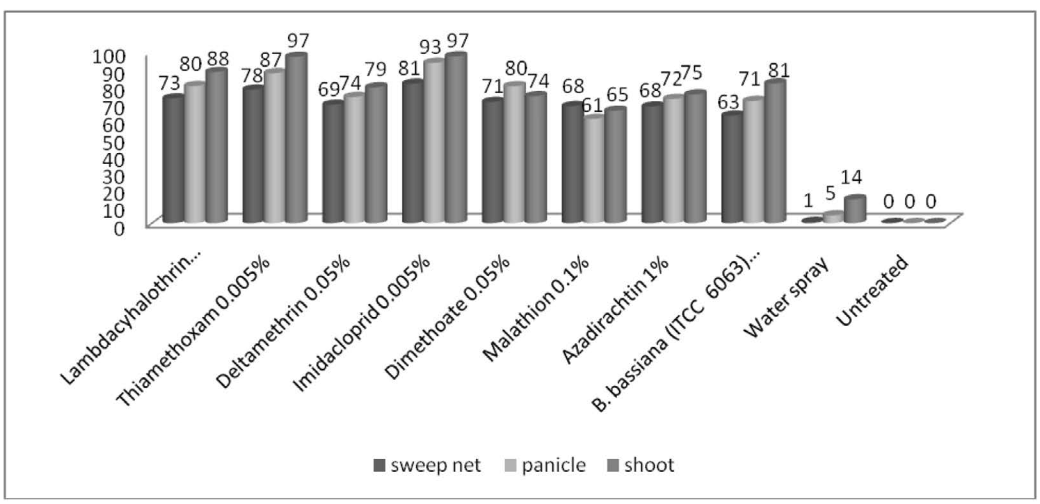

Fig. 4. Impact of insecticides on the population of natural enemies.

of NEs in mango ecosystem (Fig. 4). Selective insecticides help in maintain the balance between the insect and natural enemy population. From the experiment it can be concluded that using Azadirachtin 1% and *B. bassiana* 2% as alternative spray with new molecules can be recommended for the better management of pest and safer towards NEs.

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