Impact of insecticides on mango pests and their natural enemies

SHIVA MURTHY*, T. JIJI and N. ANITHA
Department of Agricultural Entomology, College of Agriculture, Vellayani, Thiruvananthapuram – 695522, Kerala, India
*Corresponding author E-mail: agrico5539@gmail.com

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.

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. 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%), lambda cyhalothrin 5 EC (0.005%), flu bendiamide 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. Lambda cyhalothrin 5 EC (0.005%), thiamethoxam 25 WG (0.005%), deltamethrin 2.8 EC (0.05%), imidacloprid 17.8 SC (0.05%), 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 Han derson-Tilton’s formula (Adnan et al., 2014).

\[
[1 - \frac{T_a}{C_a} \times \frac{C_b}{T_b}] \times 100
\]

**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 inflorescence | 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
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 \textit{B. bassiana} 2% as alternative spray with new molecules can be recommended for the better management of pest and safer towards NEs.

REFERENCES

Adnan SM, Uddin MM, Alam MJ, Islam MS, Kashem MA, Rafii MY, Latif MA. 2014. Management of mango hoppers, \textit{Idioscopus clypealis}, using chemical insecticides and neem oil. \textit{Sci World J}. \textbf{2014}: 5, https://doi.org/10.1155/2014/709614.

Anithakumari D, Lakshmi BKM, Reddy SG, Reddy LM. 2009. Influence of abiotic factors on the incidence of hopper and chemical control strategies in mango. \textit{Karnataka J Agric Sci}. \textbf{22}: 601-602.

Carmo EL, Bueno AF, Bueno RCOF. 2010. Pesticide selectivity for the insect egg parasitoid \textit{Telenomus remus}. \textit{BioControl} \textbf{55}: 455-464. https://doi.org/10.1007/s10526-010-9269-y

Chakrabarti S. 2014. Bio-ecology of mango hoppers and their species diversity in lower Gangetic alluvium region - A review. \textit{Trends Biosci}. \textbf{7}: 2353-2356.

Fernades FL, Bacci L, Fernandes MS. 2010. Impact and selectivity of insecticides to predators and parasitoids. \textit{Entomobrasilis} \textbf{3}: 1-10. https://doi.org/10.12741/ebbrasilis.v3i1.52

Hati SR, Sahoo SK, Jha S, Saha A. 2005. Population dynamics of mango hopper as influenced by abiotic factors in new gangetic alluvial zone of West Bengal. \textit{J Environ Ecol}. \textbf{23}: 314-318.

Kannan M, Rao NV. 2006. Ecological studies on mango leaf webber (\textit{Orthaga exvinacea} Hamp.) in Andhra Pradesh as a basis for IPM. \textit{Int J Agric Sci}. \textbf{2}: 308-311.

Kumar S, Bhatt RI, Patel BN. 2005. Ecological studies relevant to the management of mango hopper, \textit{Amritodus atkinsoni} Lethiery. \textit{J Appl Zool Res}. \textbf{16}: 67-69.

Kumar S. 2006. Population dynamics and some management aspects of mango hoppers. \textit{J Appl Zool Res}. \textbf{16}: 64-66.

Manjunatha R. 2015. \textit{Population dynamics of mango leaf hopper and their management}. Ph. D. (Ag) thesis, University of Agricultural sciences, Dharwad, Karnataka, India, 66 pp.

Masanori T, Hayami N, Fujioka S. 2005. Flubendiamide, a novel insecticide highly effective against lepidopteran insect pests. \textit{J Pesticides Sci}. \textbf{30}: 354-360. https://doi.org/10.1584/jpestics.30.354

NICRA [National Initiative on Climatic Resilient Agriculture Team of Mango Pest Surveillance]. 2012. Manual for Mango Pest Surveillance. National Centre for Integrated Pest Management, New Delhi, 39 pp.

Samanta A, Ghosh A, Hembram TK, Patra S, Somchowdhury AK. 2009. Efficacy of insecticides against mango hoppers and fruit yield. \textit{Ann Pl Prot Sci}. \textbf{17}: 243-244.

Singh S, Verma R. 2013. Factors influencing the incidence of mango leaf webber, \textit{Orthaga euadrusalis} Hampson, (Pyralidae: Lepidoptera) in mango and their management. \textit{Mol Entomol}. \textbf{4}: 22-25.

Verghese A, Rao GSP. 1987. Determination of relevant critical stages for the management of the mango hopper, \textit{Idioscopus clypealis} Lethiery. \textit{Indian J Hort}. \textbf{44}: 280-283.