Study on biological and integrated pest management of hemipteran pests (The Asian citrus psyllid) on citrus fruits

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Abstract

Aquatic insects are important pests of aquatic plants, but their control is often difficult because of their ability to fly and hide in water. The goal of this study was to evaluate the efficacy of an integrated pest management (IPM) approach for controlling hemipteran pests on citrus fruits. In this study, we evaluated three IPM approaches: biological control, chemical control and integrated pest management for controlling Hemiptera species that cause damage to citrus crops. Biological control is based on use of natural enemies as predators or parasitoids; chemical control uses chemicals such as insecticides or fungicides; while IPM combines both biological and chemical controls with other methods such as cultural practices like crop rotation and sanitation measures like hand picking. The study involves study of recent literature concluded in domain of biological and integrated pest management practises to control hemipteran pest on citrus fruit from year 2015 – 2017.

Keywords – *Aquatic insects, Integrated pest management, Biological control, Chemical control, Hemiptera species.*

1. Introduction

The main objective of this study was to determine the effects of different insecticides on Hemipteran species and an integrated pest management strategy control their presence on citrus fruit. The common species of hemipter order is The Asian citrus psyllid (*Diaphorina citri),* a small, invasive insect that transmits the deadly citrus greening disease (Vyas et al. 2015). The Asian citrus psyllid was first discovered in Florida in 2002 (Chen and Stelinski 2017) and has spread throughout the state. This pest can be controlled by spraying with pesticides such as pyrethrum or rotenone, but it's not always effective because of its ability to develop resistance to these chemicals over time (Ndakidemi, Mtei and Ndakidemi 2016).

In India, the citrus fruits are grown in various parts of the country. The main areas of production include Maharashtra, Gujarat, Tamil Nadu and Karnataka (Bala and Kumar 2017). Citrus is also grown in many other countries such as Australia, China (including Taiwan), Fiji Islands, Indonesia (especially Java), Japan and South Africa (Vernin and Parkanyi 2016). In India, the most common citrus pests are aphids and mealy bugs (Kundoo, Khan and Studies 2017). The eggs of the mealy bug "Aphis citricolor" can be found on all parts of the plant except for the fruit. They are very small, white and oval shaped. They have a single row of spines along their backs which makes them difficult to remove from leaves without damaging them. Their life cycle is about 10 days long and they produce three generations per year in tropical climates like India. The adult

female lays her eggs on young shoots or leaves near the base where she dies after laying her eggs. The larva develops into an adult within two weeks after hatching and continues to feed on new growth until it reaches maturity when it stops feeding entirely before pupation takes place over 2–3 months later at nightfall during winter months (October-January). This species has been reported as being very destructive in some parts of India including Kerala, Karnataka, Tamil Nadu, Andhra Pradesh and Maharashtra where they cause severe damage to plants by eating leaf tissue causing stunting growth with yellowing foliage followed by death in severe cases (Kundoo, Khan and Studies 2017). In such circimstances it becomes very important to find out ways for biological and IPM strategies to control hemipteran pest *(The Asian citrus psyllid)* on citrus fruits.

Fig.1 The Asian citrus psyllid) on citrus fruits

Fig.2 Greening of citrus fruit

2. Literature review

The psyllid has been reported from various citrus cultivars and it is now considered that this insect may have originated in Asia and then spread to other parts of the world (Boina and Bloomquist 2015). The citrus psylla is a small, slender, elongated and wingless insect. It has a black head with two pairs of eyes, one pair on the top side and the other pair on the bottom side. The body is covered with short setae (hairs) which are also found in its legs. The antennae are long and thin but not visible from above as they are hidden under the body.

The citrus psylla feeds on several species of plants including "Citrus" spp (Milosavljević et al. 2017)., "Mangifera indica" (Diaz et al. 2015), and others; it prefers to feed on young leaves or tender shoots at night when nocturnal insects are active. In some cases it can be seen feeding during daytime as well by using their proboscis (sucking tube) (Stanley, Preetha and Stanley 2016).

This species lays eggs singly or in clusters that contain up to 30 eggs each; these eggs hatch within 10 days after being laid into soil, water or leaf litter where they develop into larvae called nymphs that remain there for

about one year before becoming adults. This process takes place mainly during summer months when temperatures rise above 15 °C but can occur anytime between March to October depending upon temperature conditions such as rainfall amount and humidity levels. Adults do not lay eggs but instead produce copious amounts of honeydew which attracts ants who will then carry them back to their nests where they will feed until reaching adulthood.

Biological control and IPM of hemipteran pests (The Asian citrus psyllid) on citrus fruits

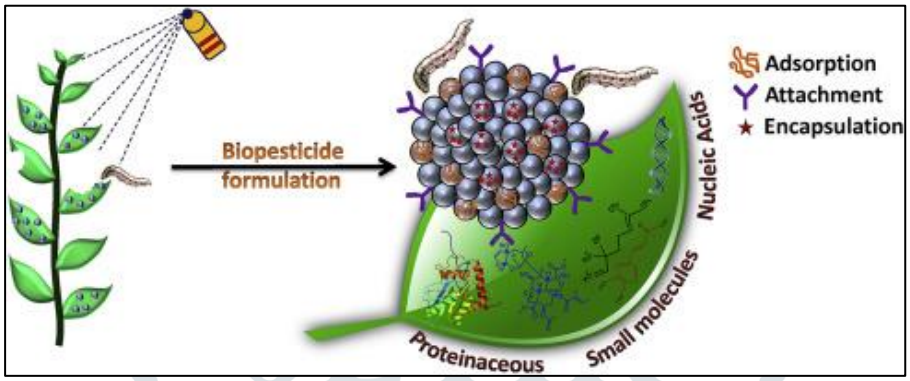

Fig.3 Integrated pest management strategy

Fig.4 Biological pest control strategy capture by hemipteran pest

The biological control program involves two stages:

(1) monitoring for natural enemies (Kistner et al. 2017); and

(2) releasing parasitoids that attack citrus psyllids in their nymphal stage or later as adults (Flores and Ciomperlik 2017).

Monitoring for natural enemies includes searching for insects that prey on citrus psyllid nymphs or adults in field plots where experimental releases are made each year from late winter through early summer until all adult psyllids have died after which time they can be harvested to determine if any parasitoids were present during the experiment period. If no parasitoids are found then this indicates that there may not be enough suitable habitat available nearby to support a population of these insects so further releases will not occur unless additional habitat is provided by landowners who agree to host them near their property boundaries such

as along roadways or other areas where they can easily access new areas without being bothered by people who do not want them around their homes/businesses/gardens etc. This method is called "random release" because no one knows exactly where the released insects will go but they are supposed to spread out over an area approximately 10 acres wide centered around each plot location used in experiments conducted during the previous year. Harvesting should be done soon after harvesting because once dead they start rotting very quickly. Once harvested need to remove any remaining eggs, larvae, pupae, and adults from field plot(s) using either insecticidal soap spray equipment or hand picking depending on what works best.

These insects have become increasingly resistant to pesticides used in pest management programs (Guedes et al. 2016). Integrated pest management is an approach to managing insect pests by combining biological control with chemical control methods such as insecticides or miticides (Fahad et al. 2015). The goal of integrated pest management is to reduce reliance on chemical pesticides while maintaining or improving crop yields.

Integrated pest management can be accomplished through several approaches:

1) reducing susceptibility of target pests through targeted genetic modification (Leftwich, Bolton and Chapman 2016);

2) increasing resistance in natural enemies (Bielza and management 2016);

3) using multiple pesticide classes (Jallow et al. 2017);

4) using synergistic combinations of pesticides (Mossa and technology 2016);

5) using non-chemical methods for controlling pests such as physical barriers (Tartanus et al. 2017), exclusion devices (Gold, Keefer and Krejci), traps (Ding, Taylor and Agriculture 2016) and pheromones (Cui and Zhu 2016);

6) developing new biopesticides (Senthil-Nathan 2015) and

7); developing new bioinsecticides which act upon specific physiological processes within the host organism rather than directly killing it (Ruiu 2015).

Conclusion

As India is an agriculture dominant country, in recent time underlying the destruction caused by various insect induced pest species harmed agricultural output majorly. Revisiting the ideas and scope of biological control and IPM of hemipteran species, would enable to devise more potent and efficient methods to protect citrus crop.

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