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Asian Citrus Psyllid: A Threat to Citriculture

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Abstract

Citrus is an important world's leading high valued fruit crop. India ranks 7th in the production and occupies 3rd position after mango and banana. Citrus is cultivated under different agro-ecological conditions from arid zone to semi-arid areas of southwest region, humid tropical climate of northeast regions. Citrus cultivation and yield are hindered by various biotic stresses, of which insect pests are prime factor in reducing the profit from the crop cultivation. The insect Asian citrus psyllid, *Diaphorina citri* is major pest causes damage directly as well as act as vector by transmitting "greening disease". There is growing interest and awareness among the citrus growers to tackle the dreaded pest and disease to sustain the productive yield for a period of 15-20 years. The symptomatology, biology and integrated strategies for the management of citrus psyllid are briefly narrated in the compilation.

Introduction

Citrus is high value fruit crop in terms of international trade. The productivity and quality of citrus is severely affected by several factors, insect pests being one of them. In India 250 species of insects have been reported on various citrus species. Among the insect pests, Asian Citrus Psyllid (ACP), *Diaphorina citri* Kuwayama (Hemiptera: Psyllidae) is considered the most destructive pest causing heavy losses in citrus growing areas and the losses ranged from 83-95 percent. This insect has become immensely important because it act as vector of the bacteria, *Candidatus liberibacter asiaticus* (CLas) that causes citrus greening disease which is restricted to the phloem vessels. Management of the pest requires knowledge on the biology and the factors which regulates psyllid population. This article provides information on the distribution, biology, spread of greening disease in citrus by psyllid and its management.

Distribution

The citrus psylla, *Diaphorina citri* Kuwayama is currently one of the most important insect-pest and a vector of destructive "Greening Disease" in citriculture. It was first reported in 1907 from Taiwan and is now well distributed across several countries, particularly it is found throughout Asia. It is known to occur in China, India, Myanmar, Taiwan, Philippine Islands, Malaysia, Indonesia, Sri Lanka, Pakistan, Thailand, Nepal, Hong Kong, Ryukyu Islands, Afghanistan, Saudi Arabia, Réunion and Mauritius. It has recently been reported in many new areas in the Americas including Mexico, Venezuela and Argentina. Psyllid, *D. citri* is widespread throughout the southern parts of Asia, from the southern islands of Japan in the east, through southern China, Southeast Asia to India and Pakistan in the west.

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Psyllid: The Main Vector for Citrus Greening

In citrus cultivation, the greening disease is a most important threat throughout the world, which reduces the fruit quality and yield. It is also known as Huanglongbing (HLB) or yellow dragon disease and it was observed for the first time in India during 1960. In nurseries, psyllids damage leads stunted growth in seedlings. This disease is caused by the bacteria, which can live and multiply in enormous within the phloem region of the vascular system of the plant. The citrus psyllid, *D. citri* is the main vector for transmission of greening disease via carrying the bacterial pathogen from infected to healthy plant while feeding (Capoor *et al.,* 1967). The citrus psyllid feeds on all varieties of citrus and citrus relatives comes under the family Rutaceae, moreover it is also preferably attacks the green curry leaf, *Murrya koenigii, Cordia myxa* and common fig, *Ficus carica*.

Biology of Asian Citrus Psyllid (ACP)

The adult Asian citrus psyllid is a tiny mottled brown insect (3-4 mm long) that is about the size of an aphid. Adult psyllids, hold their wings in a roof-like position over their body (Figure 1 and 2). The fore wings have a brown band that extends around most of the wing-margin; the antennae are brown with black tips. The adults are found most often gathered on stems and are typically covered with a white waxy secretion that makes them look dusty, when disturbed it will jump away or hide on the underside of a leaf (Shivankar *et al.,* 2000). The feeding behavior of this psyllid is peculiar that the adults feeds by positioning its head down towards the leaf lamina, while feeding the plant sap the rest of the body is slightly raised from the leaf surface at an angle of 45° with its tail end in the air. The adult females can lay 500 to 800 or more eggs over a period of two months with a maximum of 1900 eggs during their lifetime. The eggs are tiny, almond shape and yellow to orange in colour. The eggs are laid during day time either singly or in clusters or in groups of double/ triple straight lines deep into the folds of newly developing tender plant feather flushes with the help of strongly pointed ovipositor and were anchored there by means of a short stalk embedded in the plant tissue. In India the psyllid species, *D. citri* is having five nymphal instars; the nymphs are orange yellow, flattened and circular in shape (Figure 3). They remain congregated close to the site of oviposition and for few days feed in the tender tissues. Subsequently, they move to older parts like matured leaves, thick shoot, petioles etc. The nymph cast skin five times and become adult in 12 to 25 days. The adults can live upto one to two months. The total life-cycle took 14-48 days, depending on prevailing temperatures. The optimum temperature range for psyllids is between 77 and 84 °F. In Asian conditions, ten overlapping generations were observed in a year with a sex ratio of 49 percent males to 51 percent females was observed in the population.

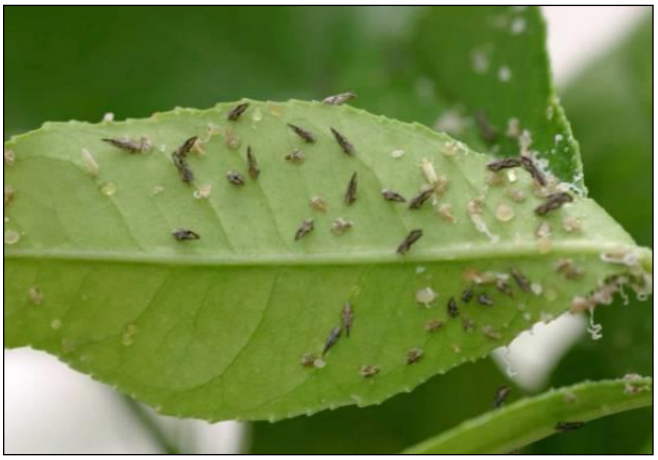

Figure 1: Congregation of psyllid adults

Figure 2: Matured adult

Figure 3: Aggregation of psyllid nymphs

Symptomatology

The psyllid inserts its mouthparts into the infected plant phloem and sucks the liquid sap acquire the bacteria and then can transmit the disease to healthy plants. The relationship existing between the greening disease pathogen

and the vector, *D. citri* is clearly shown to be a circulative type. The psyllid requires an incubation period of about 21 days in which to transmit the pathogen, which it retains for life following a short access feeding on a diseased plant. Apparently most of the psyllids in orchards usually acquire the pathogen as 4th- and 5th- instar nymphs, and become vectors for life after going through a latent period of 5 to 9 days. It is not essential for adult psyllids arising from infectious nymphs to have feeding on diseased shoots in order to become vectors (Hoy and Nguyen, 2001). The initial symptom is yellowing in few or more terminals shoots. The infected leaves indicate multiple shades of yellow and green called blotchy mottle (Figure 4). The patterns of blotching are asymmetrical and these distinguished symptoms of citrus greening resemble the similar symptoms caused by deficiencies of minerals such as zinc, manganese, magnesium, calcium and iron. The disease also deforms the fruit and causes the color to revert to green and the affected fruits do not concentrate sugar and become bitter. Once infected, trees usually decline and die within 3 to 5 years. The bacteria can also spread during grafting plants with infected plant material.

Figure 4: Symptom of citrus greening

How to Manage?

• The most effective ways to minimize the risk of infection is to avoid moving plants and plant materials from areas under regulatory quarantine or where the insect or disease is present.

• Periodical inspection of citrus orchards to assess the ACP activity and symptoms of greening disease in leaves.

• Collection and destruction of diseased leaves and twigs along with the population of psyllids.

• The best way to avoid losses due to citrus greening is keeping crop hygiene with disease free healthy plants in the orchard.

• Erection of yellow sticky cards @ 10 /ha for detection and monitoring of psyllid to take up necessary management actions.

• As part of long-term management strategy, encourage the activities of predators such as syrphids, chrysopids, several species of ladybeetles like *Coccinella septumpunctata, C. rependa, Chilomenes sexmaculata, Chilocoruss nigritus, Brumus suturalis,* the parasitoid *Tetrastichus radiates* and wasp, *Tamarixia radiata*.

• Spray botanicals *viz*., NSKE 5% or Neem oil 2% immediately after the symptoms noticed.

• Application of contact insecticides cannot assure the control of all the stages of psyllid, because the adults can fly but other life stages; eggs and nymphs tucked inside the new foliage. Hence the selection of insecticide with systemic action is good for management.

• Spray any of the insecticides, Dimethoate 30 EC 3.0 L, Quinalphos 25 EC 1.0 L, Imidacloprid 200 SL 250 ml, Thiamethoxam 25 WG @ 150 gm in 1500 L of water per ha during March and again in September at flush growth periods.

• Spraying of Insect growth regulator, Pyriproxyfen 10% EC @ 1 ml/litre of water to target nymphs in rotation with insecticides to reduce the risk of resistance development in insects.

Researchable Issues

Biotechnological studies are in progress on to manage this citrus psyllid in effective way. The use of RNAi interference against *D. citri* is studied to manage the pest populations. R2D2, the cofactor of Dicer-2, was absent in *D. citri*, which is essential to develop the RISC complex. But interestingly, high dose of dsRNA sufficiently suppress the expression of a fertile gene DcBol. This technology can suppress the insect population and will be an effective tool to incorporate in the integrated management strategies.

Conclusion

The Asian citrus psyllid, *D. citri* is one of the major threats to sustain the productivity of citrus in various parts of India and South Asia. It can be effectively managed by timely diagnose of greening disease and by following the proper management strategies in integrated way. The periodical inspection of citrus orchards, keeping the orchard with crop hygiene, encouraging the activities of predators and parasitoids along with timely protection through recommended insecticides are the best way to avoid losses due to citrus psyllid. The advances in biotechnological tools such as RNAi interface can supplement the IPM package by taking up more research works on the concept.

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