Aphid Pest Management with Neuroptera (Insecta)

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Abstract

Aphids attack a wide variey of plants, both cultivated and wild and are established as major pests of several economically important plants. Among the predator members of aphids, the order Neuroptera is very important. Three larval instars of all three families of Neuroptera (Chysopidae, Coniopterygidae, Hemerobiidae) are found to be active predators, as are some of the adults. Owing to their carnivorous habit, free living Neuropteran larvae attack and kill aphids. Neuroptera may be used effectively in the biological control of aphids.

Key words: Neuroptera, aphid pest management, biological control

1. Introduction

The insect order Neuroptera of Insecta comprises of the lacewings, mantidflies, antlions and their relatives. They are cosmopolitan in distribution and in general exhibit a carnivorous habit. The larvae of many species and the adults of a some species are predaceous on many insects like aphids, coccids and other soft-bodied insects. As many of these prey insects are recognised as pests, Neuroptera are valuable allies of Man. Besides being predators, a few Neuropteran species are also parasitic in habit and parasitize the egg capsules of some spiders.

2. The Beneficial Insect Neuroptera

Neuroptera as a group contains insects that feed on other insects, at least during part of their life cycles, so they are generally regarded as beneficial. The name Neuroptera means 'nerve winged', and is derived from the many veins and closed cells in the wings. Some Neuroptera larvae are commonly known as 'Aphid-lion', because they are frequently found in association with aphids. Owing to their carnivorous habit, free living Neuropteran larvae attack and kill aphids. They suck up the aphid body fluid which serves as food for their development and maturity. Thus Neuroptera may be used in biological control of aphids, which cause immense plant damage due to their phytosaccivorous nature. Among the predator members of aphids, the order Neuroptera is undoubtedly very important. Members of the three families of the order; Chrysopidae (the green lacewings), Coniopterygidae (the dusty wings) and

Hemerobiidae (the brown lacewings) are widely distributed throughout the world and are particularly found to prey upon aphids. Another family, Dilaridae have a relation with small soft bodied insects as prey[1].

3. The Notorious Aphid

Aphids are a group of notorious insects belonging to the family Aphididae of the order Homoptera. The aphids enjoy a more or less cosmopolitan distributon and are found in abundance in temperate climate. They attack a wide variey of plants, both cultivated and wild and are established as major pests of several economically important plants[2]. They are phytosaccivorous and draw sap from the sieve tube of phloem in plants. Every part of the plant like roots, stems, leaves, inflorescence, fruits and seeds may be exploited for their food. They cause damage to the host plant by sucking sap and devitalizing the plant body. As a result of aphid attack normal growth of the plant and development of inflorescence, fruits and seeds are hampered. Various malformations[3] and a decrease in the number of viable seeds may be the result[4,5]. A byproduct of their probing and feeding behaviour is the transmission of many plant viruses[6]. Aphids form the largest group of insect vectors of viruses. About 370 aphid species are involved in the transmission of 300 plant viruses[7]. *Myzus persicae* (Sulzer) alone transmits 90 different viruses[8].

4. Need for Biological Control

Insecticides are generally used in pest management. But the use of these chemicals to control pests has brought in its wake a number of pressing problems. Resistance of the target pests to pesticides, quick resurgence of insects following the indiscriminate use of insecticides, promotion of the previously known benign or minor insect species into major pests, depletion of the predators and other natural enemies are the common side effects of insecticides. Chemicals destroy all insects irrespective of whether they are beneficial or not and contaminate the environment, threatning the well being of the other creatures[9]. The effectivity of natural enemies in curbing the pests depends upon their food ecology. The development of resistance to pesticides and toxicity to the non target organism is largely responsible for the attention on biological control.

5. Use of Neuroptera in Aphid Pest Management

Three larval instars of all three families of Neuroptera (Chysopidae, Coniopterygidae, Hemerobiidae) are found to be active predators, as are some of the adults. Adults of Chrysopidae (green lacewings) feed on honeydew and pollen, some feed on aphids too, and thus they may be attracted to the vicinity of aphids. Green Lacewing (family Chrysopidae) larvae are voracious eaters of the eggs and immature stages of many soft bodied insect pests, including several species of aphids, spider mites (especially red mites), thrips, whitefly, leafhoppers, some beetle larvae, eggs and caterpillars of pest moths, and mealybugs. The larvae will eat for 2-3 weeks, spin a cocoon, and 10-14 days later, emerge as adults. In

general, green lacewing adults have delicate, pale green bodies, golden eyes, and transparent wings. A common species of green lacewing is *Chrysoperla carnea.* Adults are 2-20 mm long, have long antennae, and are active flyers during the evening. Female green lacewings lay distinct eggs on the undersides of leaves, and are individually attached to a ½″ hair-like filament or stalk. The stalks help protect the eggs from predation. Chrysopidae are larger and more conspicuous than Hemerobiidae, so they are often more voracious, more fecund. It has been estimated[10] that of the approximately 80 green lacewing species in the Mediterrianean region, about 20 are part of the natural beneficial fauna in the crops and the anthropic environment.

The Coniopterygidae (dusty wings) with their small size wingspan is between 1.8 and 5 millimetres - and their translucent brownish wings usually covered with the namesake whitish dust of waxy scales. Dustywings are strongly associated with woody plants, on and around which they usually spend their entire lives. Females depost their eggs singly on bark or leaves. Dusty wing larvae are around 3.5 mm long. Their mouthparts consist of short, straight sucking tubes covered by the labrum. They are crepuscular and dwell on shrubs and trees, where they feed on small invertebrates like scale insects, aphids and mites, as well as on arthropod eggs; the mouth tubes are used for sucking fluids from the prey.They are often found on trees supporting large population of aphids and are not usually common on field crops or other low growing vegetation.

Brown lacewings (family Hemerobiidae) are not as commonly seen as green lacewings because they prefer wooded areas. Brown lacewings are typically smaller than green lacewings, and have light brown bodies and transparent wings. They are predatory both as larvae and adults and help contribute to early-season pest control. Hemerobiidae (brown lacewings) are characteristic of low vegetation, sometimes as a part of a very broad habitat range. Their developmental threshold temperature is very low, usually lower than those of most other predators and aphid prey[11]. Thus giving them added advantage and important role in biological control early in the season, when aphid population is very small[12]. In temperate climate they are active throughout the year and some Hemerobiids are able to complete a generation within a few weeks by feeding on aphids. They also produce considerable number of eggs. Larvae of some Hemerobiidae are very active searchers.

The importance of Neuroptera as predators of aphids has been overshadowed by greater attention paid to more abundant predators like syrphids and coccinellids. Of the total natural enemies used in the world for biological control, only 5.33% of the order Neuroptera has been used as natural enemies[7]. But during early months of the year, Neuropterans become the most abundant predator found to predate on aphids. So, they have the potential to be more significant in reducing aphid numbers and may become important during periods when the coccinellids are absent or inactive[11]. Some lacewings overwinter as larvae and may be efficient predators. They can be used to help controlling aphids in winter[13].

6. Use of Neuroptera in Aphid Pest Management in India

Several aphid associated insects and their role as predators are known from the Indian region. Many such predators may help in suppressing the aphid infestation below the economic threshold level. More studies are needed to critically estimate their effectiveness as predators. The research on aphidophagous Neuroptera in India is scanty compared to the other groups of insects. Information on use of Neuroptera in pest control from India can be got from the works of few workers [14-17] . These studies are concentrated mainly on Eastern Himalaya and some parts of Eastern Ghat. Studies on Neuroptera from the Western Himalayan region were carried out by some workers [18- 20] .

As taxonomy, biology, ecology and utilisation of natural enemies are basic components of biological control, more intensive studies on Neuroptera as natural enemies of aphids is of utmost need. It may be noted that these informations may provide essential basic data for a thorough understanding of the ecological and behavioral problem of the target species as well as their habitual enemies. Thus, utilisation and exploitation of Neuroptera as biological control agents may be possible, and would help to formulate a biological control programme against aphid pest.

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