Coccinellidae Beetles in Pest and Disease Management

Vijaya Kumari Nelaballe and Beula Priyadarshini Meruva

Abstract— Biocontrol of pest and disease using natural enemies is one of the best alternatives over chemical control among various predators, *Coccinellidae* beetles are major biocontrol agents widely used and also one of the potential agents. In the present study a brief description about three important Coccinellidae biocontrol agents for the management of Mealy bug, Scale insects, Spiralling whitefly and Powdery mildew disease. *Cryptolaemus montrouzieri (*Australian lady bird beetle*)* and *Scymnus coccivora* are the two major natural enemies which are commercially available for the management of mealy bug, scale insects and aphids. *Illeis cincta* which is a mycophagous coccinellidan beetle is found to be potential predator on the conidia of powdery mildew. These three natural enemies can be used for the management of major pests and diseases of many crops.

Keywords—Biocontrol agents, *Coccinellidae* beetles, *Cryptolaemus montrouzieri*, *Scymnus coccivora, Illeis cincta*..

I. Introduction

AGRICULTURE revolution has lead to depend on various agrochemicals to improve the crop produce. Indiscriminate use of chemicals has resulted in environmental toxicity, mortality of beneficial organisms, ecosystem imbalance and adverse effects on human and other living population. By realizing the need for an alternative, in recent years biocontrol of pests and diseases is being viewed as one of the best alternative to the chemical control. Biological control has a broad meaning which refers to the manipulation of population of pathogens or pests. It can be achieved either by introducing or releasing species or providing or implementing congenial conditions for natural enemies of a pest, pathogen or parasite. Because of growing concern to the ecologically safe management methods for pest and disease control, biocontrol methods using natural enemies for various pathogens and pests of crop plants is becoming more and more popular because of its varied advantages to the global security especially for the nature and living population.

Among the various natural enemies or bioagents the *Coccinellidae* beetles are the most successful and potential users in pest and disease management strategies. In this study various *Coccinellidae* beetles and their potential application in the field of bio control has been emphasized along with a case study.

The present study aims to bring out the potential uses of important *Coccinellidae* as biocontrol agents which give information to the researchers, students and academicians.

To carryout research, develop knowledge in the field of crop protection through ecofriendly methods.

Vijaya Kumari Nelaballe is working as Assistant Professor in the Dept.of Sericulture,SriPadmavatiMahila(Women's)University,Tirupati517502.Andhra.Pradesh,India Email.ID.annievij28@gmail.com.

Beula Priyadarshini Meruva is a Research Scholar in the Department of Sericulture,SriPadmavatiMahila(Women's)University,Tirupati517502. Andhra.Pradesh,India.Email.ID:dany.beula7@gmail.com

II. Importance Of *Coccinellidae* Beetles As Biocontrol Agents

In any biocontrol strategies three attributes play major role for its successful implementation. These three attributes are 1.Host specificity 2.voracious feeding habit 3.Short gestation with high fecundity. Though all the *coccinellidae* do not show all these attributes many of them exhibit a range of prey specificity .The coccinellidans are relative generalists though they show preferences for particular habitats. Many species survive on alternative feed or supplementary food for longer periods to sustain their population.

Because of the sustainable nature of the coccinelidans many of the species are being used as potential biocontrol agents for the suppression of various pathogens and pests.

There are a number of species of lady bird beetles with good antagonistic nature, among them the following are few of the potential agents.

1. ***Cryptolaemus montrouzieri Mulsant***: It is one of the best voracious predators on mealy bug pest which attacks many of the crop plants. `Mealybug infestation is one of the major menace in crop plants especially in potato, okra, mulberry, hibiscus, brinjal and so on. It is a notorious pest of many of the crops with high resilient to pesticide application. The larvae of Australian lady bird beetle or *C.montrouzieri* larvae produce wax like substance that mimic that of mealy bug which enables them to feed on mealy bug larvae in the presence of tending ants that attack other parasites and predator.(1), (7).

C.montrouzieri is a predator of mulberry, grape wine, citrus, hibiscus and long tailed mealy bug. It is a voracious feeder and a single larva consumes up to 250 small mealy bugs. Adults and young larvae prefer to feed on mealy bug eggs, older larvae attack any stage of mealy bug. Adults will fly and move large area in search of food. If mealy bug availability is scarce, they can survive on aphids and soft scales insects.

Commercial availability: *C. montrouzieri* is available commercially as bottles containing adults at 25,100,500 and

2500 each. The bottles contain paper strips as perching material. As soon as mealy bugs are seen in the field *C. montrouzieri* should be introduced and especially during cooler hours of the day as the beetles is sensitive to high temperature. 2-3 adult beetles per $m^{2,}$ If infestation is high 10-12beetles /m^2 should be released.

11. ***Scymnus coccivora Ayar***:

This coccinellid is native to India. The biology and behavior of *S. coccivora* are specifically adapted for attacking mealy bugs and scale insects and does not pose any risk to crops or human and animal health. These will apparently persist at lower mealy bug populations. Species of *Scymnu*s are well known in tropical areas as predators of scale insects, mealy bugs, aphids and other soft-bodied arthropods. It was also reported from Pakistan (10), (11) (6). According to CABI BIOCAT database, more than 50 species of this genus have been introduced in various countries to control 27 species of homopteran pests.

Scymnus spp. has been used most successfully used in biological programmes against mealy bugs (*Pseudococcidae)* and woolly aphids (Adelgidae).

Adults locate prey by visual and chemical stimuli, particularly those associated with the waxy flocculence and honeydew produced by the host and larvae detect prey primarily tactile stimuli (3), (9).

The preferred host stage of *S. coccivora* appears to be hibiscus mealy bug eggs, however larvae can often be found buried within the ovisac of its prey. There are widely divergent reports on host feeding patterns of *S. coccivora F*emale produces 46 eggs and each grub eats 300 eggs of mealy bug 60 nymphs and 5-6 adult flies.

Commercial availability: *S.Coccivora* is available commercially as bottles containing adults at 25,100,500 and 2500 each. A dosage of 500 beetles/acre is required to control mealy bugs.

Although the *Coccinellidae* are mainly entamophagous which are mainly natural enemies of plant pests and few are phytophagous becoming pests. But mycophagy is also seen in some species of Coccinelidae which are playing a major role in disease control. Facultative mycophagy may be common place in the largely aphidophagous tribe Coccinellini Weise (8). These predators are often polyphagous, feeding on pollen, nectar, honeydew, fungi, fruit and foliage, but specific animal foods (e.g. aphids)are necessary to complete development (4) Facultative mycophagy, or mixed feeding on pollen, mildews (Erysiphales) and aphids has been reported in *Rhyzobius litura* (F.) (12) and *Propylea quatuor decimpunctata* (L.) (14); (5). Some genera like *Psyllobora* and *Illeis mulsant* are obligate mycophages. Facultative mycophagy has been reported from the aphidophagous Coccinellini and the Polyphagous Tytthaspidini. Members of Halyziini, a cosmopolitan tribe of the Coccinellinae, are obligate mycophages specializing on the powdery mildew fungi of Erysiphales, a ubiquitous order infecting almost 10,000 angiosperm plants worldwide (13).

III. Occurrence Of Illeis Cincta On Powdery Mildew Of Mulberry – A Case Study

Mycophagy of *Illeis cincta* coccinellidan beetle was observed on mulberry infected with Powdery mildew caused by Erysiphales fungus Phyllactinia *corylea* at Sri Padmavati Mahila University, Tirupati campus during 2011-14.

Mulberry (*Morus spp*), the main food source of Silkworm *Bombyx mori* .L .is vulnerable to many diseases and pests which adversely affect mulberry leaf yield finally the silk cocoon quality and yield. Among various fungal diseases Powdery mildew is one of the important disease which causes about 15-20% yield loss. This disease is more prevalent in winter season (September to March) and its incidence varies from place to place, cooler the area higher the percentage of incidence. This disease causes white powdery patches on the lower side of the leaf. As the disease advances chlorotic lesions develop on the upper surface turning the entire leaf black. This disease results in nutrient depletion in the leaf and the leaf becomes unsuitable for feeding the silkworm and finally it leads to cocoon crop loss.

Management of powdery mildew is generally carried out by chemical fungicide Carbandazim or Karathane. But management with biocontrol agents or natural enemies is one of the best alternatives for chemical methods.

Hence, a study was conducted to observe the natural enemies of powdery mildew fungus and trails were done for culturing and establishing natural enemy.

Illeis cincta predation on *phyllactina* conidia was observed on mulberry. The bionomics of *Illeis cincta* was also studied.

Studies on the bionomics of *Illeis cincta*:

Adult beetle: The body of adult beetle is oval and yellowish in colour .The adults are found on the leaves infected with powdery mildew especially on the lower surface where fungal patches are visible. The number of adults observed were around 8 to 10.The life span of adults was observed as 24 to 26 days on an average.

Eggs: The eggs are white and elongated which are laid in cluster of 10-15 and attached to the surface of the leaf. Egg stage lasts for 2 to 3 days.

Grubs: Five stages of grubs were observed which are yellow in colour with black spots and hairs on the whole body. The size of the body varied according to the stage of the grub. On an average the larval period lasts for 25-28 days. The third to fifth instar larvae were found more voracious than young instars feeding on the mycelia and conidia of powdery mildew.

Pupa: Pupae are yellow in colour and pupal period lasted for about 16.50 days on an average.

Feeding behavior of *Illeis cincta*: In the preliminary studies it was observed that 3rd to 5^{th} Instar grubs are very active and voracious in feeding the conidia of powdery mildew fungus. The disease severity and feeding behavior of *Illeis cincta* was observed by counting the number of conidia on each infected leaf and before and after predation. It was observed that the grubs of *Illeis cincta* are more effective in

bringing down the disease severity. From these preliminary studies it was observed that *Illeis cincta* can be used for the management of Powdery mildew, which can be an alternative to chemical method. But some more studies are needed for establishing the *Illeis cincta* to prepare bioagent formulation.

IV. Conclusion

Many of the *Coccinellidae* beetles are proven as potential natural enemies for various major pests and diseases, better exploitation of these bioagents can be made as an alternative for chemical control with many advantages.

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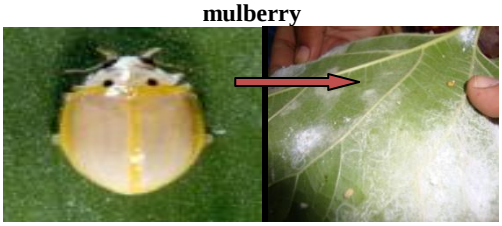
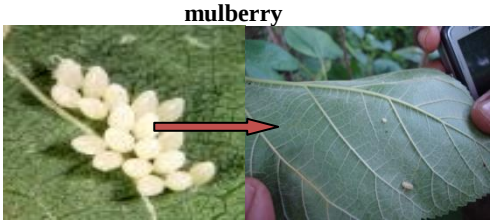
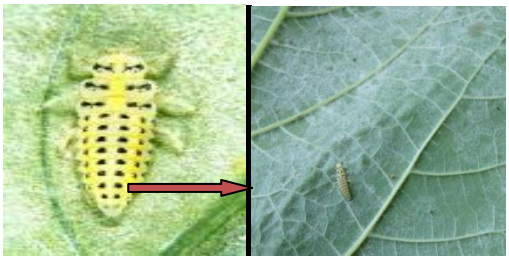
***Illeis cincta* adult beetle on spiraling white fly infested mulberry**



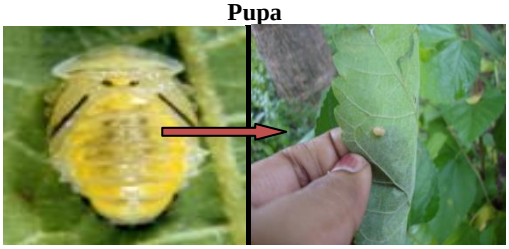
Eggs on mulberry leaf infected with powdery mildew mulberry



Grub



Pupa



***Cryptolaemus montrouzieri* culture on mealybug infested pumpkin**

***Scymnus coccivora* beetles**