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Ecological status of predatory zigzag ladybird beetle (*Cheilomenes sexmaculatus*) of cotton pest management with reference to environmental conditions around Ghugus region, district Chandrapur (M.S.) India

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Abstract
A field survey was conducted during the month of August to December 2023, at three sites of four different villages around Ghugus region. In the present study under natural conditions it was observed that zigzag ladybird beetle, adult as well as its larvae stages are more voracious in nature in order to control most of the sucking pests such as aphids, mealybugs, whiteflies, thrips etc., are common pests of cotton. Majority of ladybird beetle are important group of biocontrol agents. Coccinellids are beneficial insects and because of their predaceous nature they are considered as the most economical and eco-friendly biological control method used against dangerous pesticides.

Keywords: Zigzag beetle, sucking pests, cotton, pesticides, biological control

Introduction

A significant cash crop in the state of Maharashtra is cotton. Of the 164 insects and mites that inhabit India's cotton crop, only 12 are economically significant (Nimbalkar, R. K., *et al*., 2009) [7]. Cotton crops are attacked by both sucking and chewing insects. Suckers include whiteflies, aphids, thrips, mealy bugs, and mites, whereas chewers include grasshoppers, termites, weevils, and lepidopteron insects (Sanghani, Nirali J., G. R. Bhanderi, and R. D. Patel 2017) [12].

The indiscriminate use of synthetic pesticides in cotton crop to control insect pests resulted in contamination of the environment, harming both target and non-target organisms. As a result, rather than pesticides, biological agents are being used to manage insect pests in cotton producing fields Mallesh, Modala, and Ch. Sravanthy (2022) [5].

Biological control, which uses natural enemies including predators, parasitoids, and diseases, is the most cost-effective and environmentally beneficial strategy. It is a key component of Integrated Pest Management and holds significant importance (Singh, N. A., M. R. Dabhi, and A. R. Mohapatra 2022) [15].

Coccinellid insects are advantageous due to their predatory behaviour. Insects are a more cost-effective and environmentally beneficial alternative to harmful pesticides. Coccinellids play a crucial role in biological control since they are predacious in both larval and adult stages, making them a popular topic for both science and practice. *Cheilomenes sexmaculatus* (Fabricius) is an aphid predator found in India, Iran, Australia, and other Oriental regions (Shanmugapriya, V., C. M. Muralidharan, and K. Karthick. 2017) [13].

The Zigzag ladybird, *Cheilomenes sexmaculata* (Fabricius), is a well-known coccinellid species distributed across India's environment. It has the capacity to manage aphid populations in a variety of agricultural environments. Studies on predator biology give information on many stages and their behaviour, which may help identify the predatory stage, build prey predator relationships, and assess the potential of its life stages for improved pest management. Thus, the current study was conducted to investigate the life cycle features of *C. sexmaculata* on Aphids (Ashwini, M., and Abhishek Shukla 2022) [2].

Consequently, the purpose of this study was to increase farmers' awareness of ladybirds as helpful insects due to their predaceous nature and to give comprehensive information about the Zigzag ladybird beetle.

Material and Methods

During the cotton growing seasons of August to December 2023, a field survey was under taken in the farmer's fields under natural environmental circumstances at three sites of four different villages around Ghugus region located at 19.93°N and 79.13°E.

For Zigzag ladybird beetle, Whole plants were observed from top to bottom, as well as both upper and lower sides of the plant leaves, at weekly intervals until crop maturity. In order to determine the life cycle of different stages *C. sexamaculatus* including their total number of eggs, larval instars, pupa, and adult, were taken as the population count of the coccinellids predators. Photographs of different stages of *C. sexmaculatus* were taken at the farmer's field using a Canon camera and idenfication was done with the aid of standard literatures.

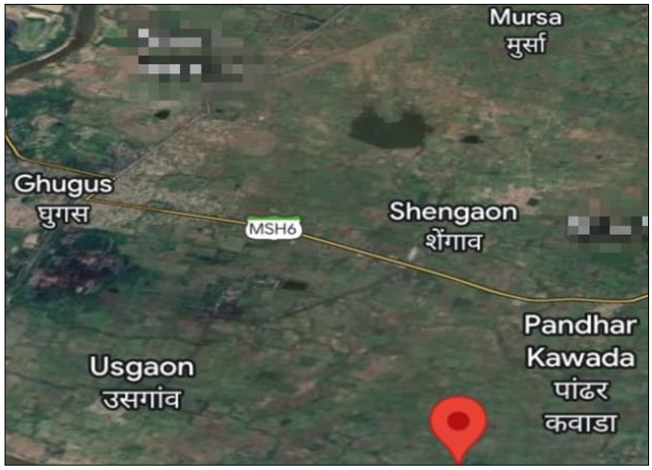

Fig 1: Satellite view of study area

Eggs (1-3 days) **Grubs (5-10 days)** **Prepupa (1-2 days)**

Pupa (2-4 days) **Adult (25-43 days)**

Fig 2: Diagram of Life cycle of *Cheilomenes sexmaculatus*

Results and Discussion

During the survey, field observation method is used in order to study different stages of *C. sexmaculatus*

Eggs

Female C. sexmaculata adults lay eggs on cotton leaf twigs near aphid colonies, either individually or in clusters of 4-22. C. sexmaculata eggs are bright yellowish, cigar-shaped, and have smooth chorion with no reticulations (Fig. 1). The eggs darkened with time and eventually became fully black before hatching. Rakhshan, Md Equbal Ahmad (2018) [10] also found that C. sexmaculata usually laid their eggs in cluster of 6 -21.

Grubs

When the eggs hatched into grubs, they went through three times of metamorphosis, resulting in four larval instars was deep black in colour which changed to dull black before reaching the pupal stage (Fig. 1). Grubs have yellowish spots on their dorsal side and ranged in color from dark blackish grey to brown. When C. sexmaculatus larvae reached adulthood, they had black bodies with yellow and white blotches, and their bodies tapered to the hind end as they grew larger. The young grubs of the species were black with lengthy legs. In the current study, it was also noted that, when feeding on A. gossypii, the fourth-instar grubs consumed more aphids daily than the other instars and adults. Navodita, Maurice, and Kumar Ashwani (2012) [6] had also reported that the 4 th instar grubs consumed significantly more aphids when compared to 1 st, 2 nd and 3rd instars per day.

Prepupa

The fourth instar larva, which was completely grown, stopped eating and became sluggish. Its bloated body was looking for a good place to pupate. The larva attached itself to its back abdominal segment to the leaf surface, and then took on a curved form to develop into a pupa. The prepupal

period period last for about 1-2 days (Fig. 1). Similar observations was found by CU, Patel Anjali Hand Shinde (2018) [3].

Pupa

The pupa that had just formed was bright yellow in colour. It eventually turns pale orange yellow. The fully grown pupa had a yellowish orange colour with a pattern of symmetrical triangular dots in two vertical lines on the dorsa side and the pupal duration varied between 2-4 days (Fig. 1). Similar observations was found by Kumar, Sanjeev, et.al., (2016) [4].

Adult

The mature beetles had oval, soft body, convex dorsally, flat ventrally, and two black lines on their elytra. They also had a posterior black patch that formed following sclerotization and melanization. The females' bigger size and abdomen help to distinguish them from the males. The total life span of males varied between 25-38 days while in the females it ranged between 30-43 days respectively (fig. 1). Similar observations was found by Venkanna, Y., *et al*. (2020) [16].

Conclusion

The main conclusion of my study is to provide useful information to the farmers by avoiding indiscriminate use of chemical pesticides in order to conserve these important Zigzag ladybird beetle. Because of their predatory nature they play a beneficial role to control pests of cotton crops and prevents cotton crops from damaging and yield better production.

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