



E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2016; 4(5): 548-551
© 2016 JEZS
Received: 20-07-2016
Accepted: 21-08-2016

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Polymorphism of *Cheilomenes sexmaculata* (Fabricius) (Coleoptera: Coccinellidae) in Haryana, India

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Abstract

The study of polymorphism related to *Cheilomenes sexmaculata* (Fabricius) (Coleoptera: Coccinellidae) was conducted during the year 2015-16 in Haryana, India. The family Coccinellidae is known for the ladybird beetle species having different morphs showing variations of elytral colour patterns within and between the species. A large number of specimens were collected by sweep nets or handpicking from the agricultural as well as wild areas of the Haryana and six different morphs of this species were identified, comprising of three melanic and three non-melanic forms. The different morphs of the species were identified on the basis of the external characters and the shape of male genitalia. The pattern of the pronotum was similar while the pattern of the elytra was quite variable in all the six types of morphs. Thus the present study documents variable elytral colour polymorphism within *C. sexmaculata* in Haryana.

Keywords: Coccinellidae, *Cheilomenes sexmaculata*, polymorphism, elytra

Introduction

Polymorphism is the existence of different individuals with different morphological, behavioural or biochemical characteristics within a population. It is the result of selection over continuous or discontinuous variations. The polymorphs having different genetic constitution appeared due to adaption to their heterogeneous environment resulting in genetic diversity. In many animal groups polymorphism led to have special features among individuals of a species [1]. In some cases polymorphism may serve to hide from predators, [2,3], while in others it gives better chances of survival in cold conditions by increasing body temperature [4-6]. Polymorphism gives a fitness advantage to the organisms in terms of feeding, mating, defending territories and escaping from predators.

Among various types of polymorphism, colour polymorphism is a conspicuous example of ecological and functional important polymorphism. Many species of ladybird beetle show elytral colour polymorphism, as indicated by *Harmonia axyridis*, *Adalia decempunctata* and *Adalia bipunctata* L. [7, 8]. Polymorphism in ladybird beetles have been studied by different scientists at different times [9-11]. Polymorphism in *Adalia bipunctata* was studied and seventeen morphs were recorded for the first time from Iraq [12]. Similarly in Japan geographical variations of elytral polymorphism in *Cheilomenes sexmaculata* was studied and twenty morphs were reported [13]. The reason for various geographical gradients related to elytral colour polymorphism in populations is not clear.

In the studies of the polymorphism, the study of ladybird beetles has occupied a special position which is related to pattern of the dorsal surface of the head, scutellum and elytra [10, 14]. In its polymorphs the melanic morphs adjust better in cold conditions than the non melanic forms [15], therefore the changes in the environmental conditions provide an opportunity for the study of morphs. Thus the environmental changes and protection from predators explains the differences in the dark colour morphs [16-18]. So polymorphism may explain the relation between different environmental factors and characters of the living organisms. The study of available literature revealed that the information related to polymorphism in the coccinellid beetles in Haryana is very scanty, with no specific previous record of polymorphism in *Cheilomenes sexmaculata* from Haryana, India. So the present study intends to find polymorphism in *Cheilomenes sexmaculata*.

Study Area

Specimens of *Cheilomenes sexmaculata* were collected from various locations of Haryana from agricultural as well as wild areas. Haryana is located between 27° 37' - 30°35' N and 74°28' - 77°36' E with altitude ranging from 200 to 1200 masl (metres above sea level).

Materials and Method

Specimens were collected by sweep net and handpicking in large numbers throughout the studied area from May, 2015 to July, 2016. Insects were killed with fumes of ethyl acetate in the killing bottle. The specimens were observed in the lab for various taxonomic characters under stereo-zoom microscope and photographed using macro lens (100 mm). The pronotum, the spots and pattern of elytra on the dorsal surface helped in differentiating different morphs of the species. Identification was carried out with the help of available keys based on morphological characters and different shapes of male genitalia [19-20].

Results

In this study, polymorphism in *Cheilomenes sexmaculata* (Fabricius, 1781) (Coccinellidae) was studied in Haryana. The ladybird beetle *C. sexmaculata* feeds on soft bodied insects like aphids, whiteflies and mealy bugs. It is distributed throughout the studied area of Haryana. This species has different polymorphic forms, exhibiting variations in elytral pattern, which could freely intermate with each other. Some intermediate forms were also found in the studied area. As some of the morphs were very similar in their external morphology with *Micraspis discolor* (Fabricius) and *Chilocorus nigrata* which could lead to misidentification of the species. Therefore besides the external characters, the shapes of male genitalia were also used to confirm the species.

Among the different specimens collected, six morphs of *C. sexmaculata* were identified on the basis of morphological characters like ground colour, pronotum, spots and pattern of the elytra on the dorsal surface (Plate 1). The species confirmation of all six was done with the shape of male genitalia (Plate 2). The description of the important characters of the identified six morphs (Plate 1) is as follows:

Morph-1. Elytra are yellowish with three zig-zag black lines: The ground colour is highly variable, it may be yellow, light red or orange with some markings as: black marking on the posterior part of the head, six black patterns on the elytra, including two black zigzag lines and a posterior black spot. It has a narrow, black and moderately broad sutural line. A T-shaped median marking connecting the broad black band along the posterior margin of the pronotum is present. This is the most prominent form of morph. This morph is commonly called as zig-zag ladybird and found throughout the year. It is a non melanic kind of morph.

Morph-2. Elytra are yellowish with black suture line and without any spot: The ground colour is yellow without any spot on elytra. It has a broad black stripe as suture line. The pronotum is of same type, as present in the morph 1. This type of morph was seen very rarely in the month of March and could be easily confused with *Propylea* and *Micrapis* species. It is a non melanic kind of morph.

Morph-3. Elytra are yellowish without any spot: The ground colour is yellow without any spot on elytra. The

sutural line is absent. The pronotum is of same type, as present in the morph 1. These types of morphs were found only during the first day of their emergence from the pupal stage and then develop in different forms according to the environmental conditions. It is also a non melanic kind of morph.

Morph-4. Elytra are completely black except margins: The ground colour is entirely black except at the margins of the elytra. The sutural line is indistinct due to the total black colour of the elytra. The pronotum is same and has a constant marking. This type of morph could be seen only during late February to early March. It is a melanic type of morph.

Morph-5. Elytra are black with two brownish spots on posterior side: The ground colour is black except at the margins of the elytra. The posterior sides of both elytra are having one brownish spot. The sutural line is indistinct due to the total black colour of the elytra. Pronotum is same as in the other forms. It is a rare type of morph found only during late February to early March. It is a melanic type of morph.

Morph-6. Elytra are black with yellow zig-zag band in the centre: The ground colour is black except at the margins of the elytra. In the middle of each elytron a single zig-zag yellow band is present which extends up to scutellum on the anterior side. The sutural line is indistinct due to the total black colour of the elytra. The pronotum is same as in the other forms. It is another very rare type of morph of this species. It is a melanic type of morph.

Discussion

The present study documents the identification of six different morphs of *Cheilomenes sexmaculata* in Haryana, India. The species of ladybird beetles show high variability with respect to the pattern of the elytra and the pronotum. Therefore the different morphs of the ladybird beetles have differences in the appearance of spot numbers, size, and pattern on the elytra and the pronotum.

In the studied area, six different morphs of *C. sexmaculata* were present which could be categorised into non melanic (morphs: 1-3) and melanic (morphs: 4-6) forms. Among these morph-1 with yellow ground colour and three zig-zag lines is the most prevalent and found throughout the year. So this morph is most successful one in the studied area. The differential reproductive success among the different polymorphs in polymorphism, under certain particular environmental conditions, lead to the success of one or two most suited morphs, in comparison to the other morphs giving the fittest an adaptive advantage in the selection. The black forms were found only during the winter season so as to absorb more light while the lighter forms reduces the heat stress in summers. These morphs may create confusion in identification on external basis, so for more confirmation, study of the male genitalia is essential.

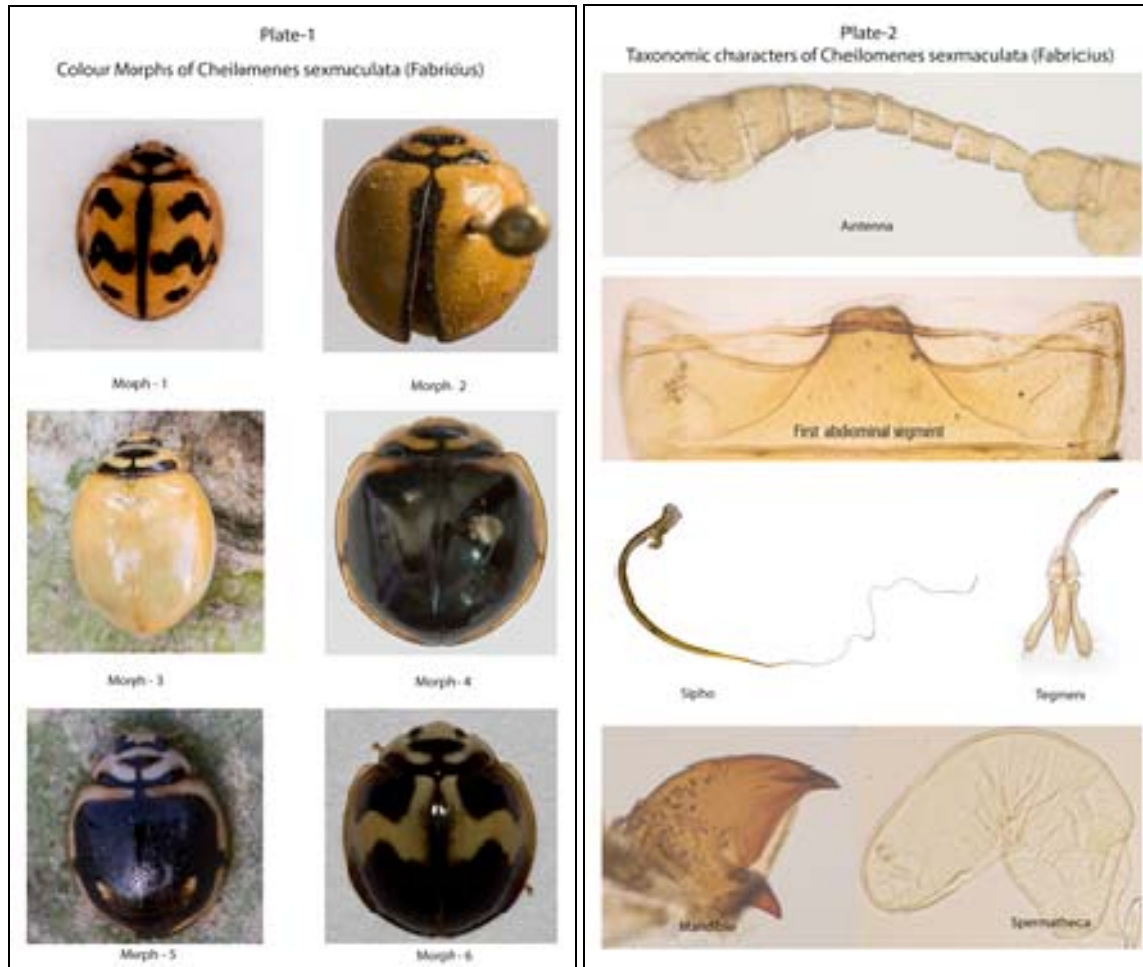
In some similar studies, Chazeau studied the genetic basis of polymorphism in elytral colouration pattern in *Coelophora quadrivittata* [21]. Biranvand and Shakarami reported 18 different morphs of *Hippodamia vareigata* Goeze in Chegeni region (Lorestan province, Iran) on pattern variation of the elytra and pronotum [22]. Kawakami *et al.* reported 20 morphs of *Cheilomenes sexmaculata* on the basis of elytra colouration, which is due to selection of morphs by the climate, throughout Indonesia to Japan [13]. While Mehdi *et al.* reported two morphs of *M. sexmaculata* among six species of

ladybird beetles on the variation of the elytral colour polymorphism in the central Iran [23]. The variability of these forms may be the outcome of their genetic constitution, or the differences in the environment in which they have been exposed, or the combination of both. On the basis of the present study it may be concluded that *C. sexmaculata* show variable elytral colour polymorphism, having six different morphs in Haryana. The findings of this study will certainly

update the present knowledge of ladybird polymorphism in Haryana, India.

Acknowledgments

The authors express their gratefulness to the UGC for providing funds and Dr. J. Poorani, Principal Scientist, Project Directorate of Biological Control, Bangalore for her help in identification and confirmation of species.



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