JHT
J.Het.Turk.
Journal of the Heteroptera of Turkey
ISSN 2687 - 3249 (online edition)
May, 2024
Volume 6, Issue 1

Research Article

About host plants and bark camouflage of *Mustha spinosula* (Lefebvre, 1831) (Hemiptera: Heteroptera: Pentatomidae)

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ABSTRACT: Fast flight and emission of pungent and foul scent fluid by meta thoracic scent gland, and secretion of excretory fluid are the dominant self-defensive means in species of Heteroptera. In addition, camouflage is also seen as a protective defense in some heteroptera species such as *Mustha spinosula* (Lefebvre, 1831).
In this study, on the camouflage behavior and protective coloration (Camouflage) of *Mustha spinosula* (Lefebvre, 1831) is focused.

KEY WORDS: *Mustha spinosula*, host plants, protective coloration, camouflage.

To cite this article: Kıyak, S., 2024, About host plants and bark camouflage of *Mustha spinosula* (Lefebvre, 1831) (Hemiptera: Heteroptera: Pentatomidae), *J.Het.Turk.*, 6(1):1-6
DOI:10.5281/zenodo.11318657
To link to this article: https://www.j-ht.org/wp-content/uploads/2024/05/V61-A1.pdf
Received: Feb 3, 2024; **Revised:** Feb 14, 2024; **Accepted:** Feb 20, 2024; **Published online:** May 31, 2024

INTRODUCTION

There are many animal species living on earth. There is diversity among animals in terms of food and nutrition, such as species that feed on plants and animals, species parasites, and predatory species. Especially in species that can fall prey to predators, various defensive features have developed, such as imitation, hiding, escape, and camouflage.

Imitation is the resemblance of one organism to another. Generally, mimicry has evolved to protect or hide from predators. (Ramya et al., 2017)

Organisms use many different strategies to avoid predators or deceive potential prey animals. Some organisms have evolved appearances and behaviors that allow them to adapt to, or mate with, some of their environment. This strategy, known as camouflage, is used by many species.

Cryptic coloring is also a type of camouflage. In insects, this involves the use of colours, patterns and textures to blend in with their surroundings to avoid predators by appearing to be part of their environment.

It is possible to find examples of camouflage among insects, caterpillars, snakes, moths, frogs and grasshoppers.

Some insects are mimics, so their ambient coloration makes them nearly invisible to their prey and protects them from predators.

According to Brakefield (2009); "A perfectly camouflaged insect is perhaps one of the most striking demonstrations of the power of evolution through natural selection to shape and adapt organisms to suit their environments, maximizing survival and reproductive success. The apparent perfection of crypsis is emphasized in many insects by the color of the wings, body and appendages. By the similarity and matching of its pattern with the background on which they normally stand. The color pattern of these different body parts and structures involves different genetic and developmental pathways, but nevertheless evolution has led to a corresponding perfect match, although completely different mechanisms of pattern formation are used. Krypsis in, color matching is almost always only one component of a survival strategy; both habitat selection and the adoption of often very specific patterns of behavior and activity. It is essential for effective encoding."

Exnerová et al (2008) reported that Heteroptera has multimodal anti-predator defenses, the main components of which are visual signals (warning coloration or cryptic colouration), acoustic signals (warning stridulation), allelochemicals (signal aversion or direct removal of toxicant).

There are many living species on earth, from insects to reptiles and even birds, that have developed ingenious strategies to adapt perfectly to the bark-covered habitats of trees.

One of the various methods of camouflage in insects is color matching with the substrate.

Color harmony: The insect's color allows it to blend in with the background, making it difficult for a predator to see.

Based on the literature, Xu, C., et al. (2022) reported: "Insects have evolved various strategies in prey-predator interactions due to selective pressures such as mimicry and camouflage. Both mimicry and camouflage provide an effective reduction in prey-predator interactions."

Among insects, imitation of leaves, branches or bark is common as an effective hiding method.

There are many different species of insects that have this type of camouflage; One of them, *Mustha spinosula* (Heteroptera), is a species belonging to the Pentatomidae family.

This species generally shows coloration similar to tree trunks and branches.

While bark camouflage is a remarkable display of nature's diversity, it is also a defensive strategy that reveals the complex relationship between animals and their environments, allowing the animal to become virtually invisible on tree bark.

Thus, blending into the background will give these insects more protection, as it is harder for predators to see them.

J.Het.Turk., 6(1), May 2024 (eISSN 2687-3249)

MATERIAL AND METHODS

This study was carried out through on-site observation and photography of the material presented.

M. spinosula samples were observed by the author in July - August 2023 at coordinates 38.48917876530996° N, 39.49584374204279° E (southeast of Elazığ/Hazar Lake, around Plajköy).

The examined specimens on the trees *Salix alba* (Figure 1) and *Acacia sp.* (Figure 2) were identified by the Author.

RESULTS AND DISCUSSION

Host tree species preferred by *Mustha spinosula* species:

According to the literature, the host plants of *M. spinosula* are given below:

It feeds on or has been found on plants from the Aquifoliaceae, Cupressaceae, Fabaceae, Fagaceae (*Quercus robur*), Juglandaceae, Oleaceae, Platanaceae, Rosaceae (*Crataegus sp., Crataegus monogyna, C. azarolus, Pirus malus, Prunus sp., Prunus cerasifera, P. amygdalus, P. spinosa*,) and Salicaceae Sapindaceae (*Acer* campestre) families (Lodos et al. 1998; Kanat & Akbulut, 2005; Rider, 2015; Rădac & Teodorescu, 2021).

And according to Fent et al (2010) host plants of *Mustha spiosula* are *Ceratonia ciliqua, Crataegus sp., Myrtus communis, Pinus sp., Pyrus elaeagnifolia, Platanus orientalis, Populus sp., Quercus sp.*

Also this species has been reported on *Cupressus pyramidalis, Quercus lusitanica*, (Fahringer, 1922), fruit trees (Hoberlandt, 1955), *Juniperus sp., Pyrus malus, Prunus amygdalus* (Lodos et al., 1998); *Acacia sp., Crataegus sp., Quercus sp., Prunus sp.* (Derjanschi & Péricart, 2005), *Cotoneaster nummularia, Crataegus monogyna, Phillyrea latifolia, Pistacia terebinthus* and *Quercus pubescens* (Dursun & Kartal, 2008).

According to Orçan (2017) this species is found in olive, various fruit trees, apple trees, forests, ornamental trees and shrubs. Among these, it is most commonly seen in cypress.

Adults and nymphs bite and suck especially the branches and trunks of trees. In cypresses, where the stylets enter, the plant tissues secrete a pinhead -sized glue.

Tek and Okyar (2017) also mention the possibility of this species being a carnivore/ predator.

In this paper, *M. spinosula* was found and photographed on the trunk barks of *Salix alba* and *Acacia sp.* (Figures 1 and 2).

Camouflage of *Mustha spinosula* (Lefebvre, 1831):

Many species of some insect families have integumentary shells that make them appear the same color as the background.

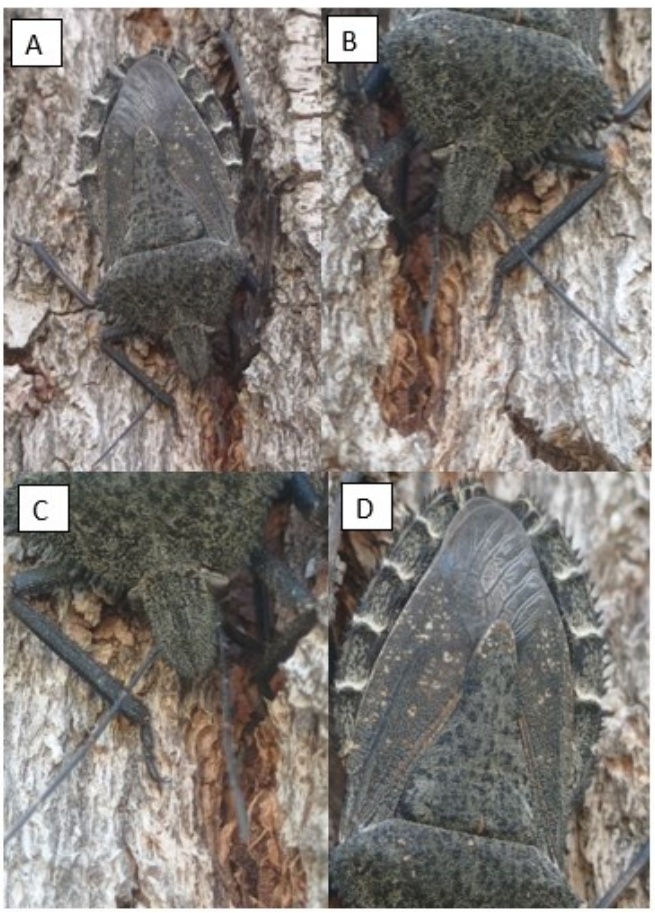
According to Johansen et al (2010), species with camouflage ability typically rely on their excellent camouflage, i.e. their colouration, which often has brown/ black/grey/yellow markings, making them extremely difficult to detect for predators such as birds.

As given above, the preferred host plants of *M. spinosula* are mostly trees, the complete list of host plants and the botanical name of the plant family is presented above.

In this research area, where observations were made, it was observed that the *M. spinosula* species provided protection against natural enemies through crypsis and camouflage with the color of the tree barks on which it was seen.

It was determined that the barks of *Salix* and *Acacia* trees were obtained by matching the bark colors of the background with the color of the insect. The adult specimen of *M. spinosula* is clearly shown in Figure 1 and 2, the insect's camouflage on the dry bark is excellent.

Figure.1 Adult specimen of *M. spinosula* (Pentatomidae) and their camouflage on dry trunk barks of *Salix alba*. (Photo by: S.Kıyak)



Figures 2. A-D) Adult specimen of *M. spinosula* (Pentatomidae) and their camouflage on dry trunk barks of *Acacia* sp. (Photo by: S.Kıyak)

J.Het.Turk., 6(1), May 2024 (eISSN 2687-3249)

This dark brown bark color matches the color of the tree bark on which they are found, thus reducing the risk of *M. spinosula* being detected by natural enemies.

This form of defense in *M. spinosula* has been observed as protective colouration, or what we might call camouflage or mimicry, so that the host plant's camouflage to its bark is so perfect that it cannot distinguish by its enemies.

This remarkable adaptation and coloration helps the insect remain inconspicuous, allowing it to escape the watchful eyes of predators such as birds and small mammals, allowing the insect to hide from both predators and prey, and allowing it to survive in the wooded environment.

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