BULLETIN OF THE IRAQ NATURAL HISTORY MUSEUM
Iraq Natural History Research Center & Museum, University of Baghdad
https://jnhm.uobaghdad.edu.iq/index.php/BINHM/Home
 Online ISSN: 2311-9799, Print ISSN: 1017-8678

Bull. Iraq nat. Hist. Mus.
(2025) 18 (3): 565-576. https://doi.org/10.26842/binhm.7.2025.18.3.0565

ORIGINAL ARTICLE

A SURVEY OF GASTROPODS IN THE GREENHOUSES OF IRAQ

Hiba Mohammed Jihad and Noor HusseinYousif ♦
* Iraq Natural History Research Center and Museum, University of Baghdad, Baghdad, Iraq.
♦Corresponding author: nhnm@nhm.uobaghdad.edu.iq

Recived: 10 June 2024, Revised: 13Feb.2025., Accepted: 16 Feb. 2025, Published:20 June 2025

ABSTRACT

The humid and warm conditions in greenhouses provide an excellent environment for pests' living conditions, and therefore, they provide ideal medium for alien introductions. Molluscs are among the most significant pests that infest plastic covered greenhouses. To identify and report their mollusc species, 23 greenhouses in Iraq were surveyed between March 2023 and April 2024. Of these, 11 were found to be infested with snails. A total of 158 specimens were collected and morphologically identified to seven species: *Monacha obstructa* (L. Pfeiffer, 1842), *Eobania vermiculata* (O.F. Müller, 1774), *Xeropicta krynickii* (Krynicki, 1833), *Rumina decollata* (Linnaeus, 1758), *Polygyra cereolus* (Megerle Von Mühlfeld, 1818), *Cochlicella barbara* (Linnaeus, 1758), and *Veronicella cubensis* (L. Pfeiffer, 1840), the latter being a slug species that is reported for the first time in Iraq in this study. With the limited knowledge about the molluscs pests in Iraq, the data presented here will provide valuable baseline information for various agricultural purposes.

Keywords: Baghdad, Invasive, Land snails, New record, *Veronicella cubensis*.

INTRODUCTION

The use of greenhouses has developed rapidly over recent decades in many regions, due to the advantages provided by these protected environments, which lead to the availability of off-season production and a production increase, enhancing fruit quality and production periods (Pardossi *et al*., 2004).

Terrestrial gastropods are among the most economically important pests all over the world, infesting plants at all stages of growth, including germinated seeds close to the surface of the soil, though not seeds themselves (Routrayand Dey, 2016). They cause severe damage and significant yield reductions (Baur and Baur, 1993). In the field land snails can be found on the soil surface, leaves, stems and fruits (Awad, 2013). Infested plant material is usually the primary cause of snails' entrance into the greenhouses from which they then spread to other plants (Hollingsworth and Sewake, 2002).

Among the main factors determining the activity of snails and slugs, moisture is the most important determinant, while temperature is also a significant factor (Moreno-Rueda, 2012). Therefore, the greenhouses provide ideal conditions for both plant life and several pests snails, maintaining stable moisture and temperature levels. Several snails and slugs species are considered agricultural pests in different parts of the world. Due to their rasping feeding mechanism, terrestrial molluscs can cause significant harm to vegetables, fruits, crops fields and ornamentals plants (Kumar, 2020).

In Iraq, greenhouses are becoming widely used across all regions. The most commonly cultivated vegetables in these greenhouses are cucumbers, tomatoes and green peppers. This study was therefore conducted to survey and assist in the identification of mollusc pests, as well as to provide a report of their presence inside the greenhouses in some localities, especially in districts known for this type of agriculture.

MATERIALS AND METHODS

Greenhouses in five locations across two governorates in Iraq, Baghdad (33.360991° N, 44.431680° E, 33°21'09.2° N, 44°25'31.4° E) and Babel (32°52'34.6° N, 44°21'37.4° E , 32.856682° N,44.411917° E (32°52'34.6° N, 44°21'38.7° E)- were surveyed (Map1). These greenhouses were divided into two categories: the first were cultivated with economic crops such as cucumbers, tomatoes and peppers, while the second were ornamental plants cultivated (Pl.1). Both live specimens and dry shells were hand collected. Live individuals were preserved in 70% alcohol (Forsyth, 1999), while feeding individuals were photographed on site to document infestation. The geographic coordinates of the collection spots were recorded using a GPS. The species identification was based on conchological characteristics such as number of whorls, shell shape and shell colour and other criteria with reference to Ali and Ramdini (2020) and Jihad and Ali (2021).

Map (1): showing the study regions.

RESULTS

Eleven out of the twenty-three greenhouses surveyed in the study area were found to be infested with seven gastropod species (n = 158 individuals), representing different genera and six families. These gastropod species which were present in dense populations caused minor leaf damage to a wide range of plants. As a result, they can be considered pests of concern in agricultural fields and gardens (both urban and suburban).

(A) Order: Systellommatophora

Family: Veronicellidae J. E. Gray, 1840

Veronicella cubensis (L. Pfeiffer, 1840) (Pl. 2).

Material examined: 20 specimens, Baghdad, May 2023, on the leaves of ornamental plants, also on the soil.

Description of species: Large, averaging 6 cm in length when relaxed, brown in colour with bluish gray eye tentacles and two dark lateral bands broken up into spots, mantle covers entire body, body texture is granular (Robinson and Hollingsworth, 2009).

Host and habitat: *V. cubensis* is a serious pest, infesting a wide range of economic, ornamental as well as medicinal plants, in both natural habitats and agricultural areas (Robinson and Hollingsworth, 2004).
Distribution: Originally endemic to Cuba (Baker 1925). Introduced to USA (California and Hawaii) (Mc Donnell *et al*., 2008), Barbados, Dominica, Nevis, Saint Kitts, Puerto Rico and Hispaniola (Robinson *et al*., 2009), Pacific Island of Rota and Guam (Robinson and Hollingsworth, 2004). This study represents the first record of *V. cubensis* in Iraq.
Note: The current study also represents the first record of the family Veronicellidae from Iraq.

(B) Order: Stylommatophora
1. Family: Achatinidae Swainson, 1840
Rumina decollata (Linnaeus, 1758) (Pl. 3A)
Material examined: 30 specimens, Baghdad, April 2023, on the soil and on the stems of the ornamental plants.
Distribution: Indigenous to western Mediterranean region, introduced to the Iberian Peninsula, Italy, southern France, the western Balkans, northern Africa (Prévot *et al*., 2014), and Iraq (Al-Qaisi and Farman, 2023).

2. Family: Geomitridae C. R. Boettger, 1909
Cochlicella barbara (Linnaeus, 1758) (Pl. 3B)
Material examined: 8 specimens, Baghdad, March 2023 and April 2024, on the stems and the leaves of the ornamental plants.
Distribution: Native to western Mediterranean region and Western Europe (Roth and Hertz, 1997), introduced to Türkiye (Ekin and Sesen, 2020) and Iraq (Al-Doori *et al*., 2018).

Xeropicta krynickii (Krynicki, 1833) (Pl. 3C)
Material examined: 6 specimens, Babel, May 2023, on the leaves of the ornamental plants.
Distribution: Eastern Mediterranean (Neubert *et al*., 2015), and Iraq (Kennedy, 1937).

3. Family: Helicidae Rafinesque, 1815
Eobania vermiculata (O.F. Müller, 1774) (Pl. 3D).
Material examined: 23 specimens, Babel, Baghdad, November 2023 and March 2024, on the leaves of the ornamental plants.
Distribution: Native to western Mediterranean region, introduced to other Mediterranean countries, such as Türkiye and Spain, also in Hungary, Germany, Japan, Australia, USA, Egypt, South Africa, Saudi Arabia, Jordan and Iran (Ronsmans and Neucker, 2016). Iraq (Al Khafaji *et al*., 2016).

4. Family: Hygromiidae Tryon, 1866
Monacha obstructa (L. Pfeiffer, 1842) (Pl. 3E).
Material examined: 46 specimens, Baghdad and Babel, collected during September and October 2023, tomato and ornamental plants, they were collected from stems and leaves.

Distribution: Iraq (Abdul-Sahib, 2005), Southern Türkiye to Iran and Saudi Arabia (Neubert, 1998).

5. Family: Polygyridae Pilsbry, 1895

Polygyra cereolus (Megerle von Mühlfeld, 1818) (Pl. 3F).

Material examined: 25 specimens, Baghdad and Babel, March 2023, on leaves, soil nearby ornamental plants, also attached to plastic potted plants.

Distribution: Saudi Arabia (Neubert, 1995), United Arab Emirates (Feulner and Green, 2005), native to Southeastern USA (Perez, 2008), Qatar (Al-Khayat, 2010), Spain (Barrachina *et al*., 2012), France (Charles, 2014), Türkiye (Frank, 2016), Libya (Liberto *et al*., 2021), and Egypt (Ali and Robinson, 2020). Introduced in Iraq (Jihad and Ali, 2021).

Plate (1): (A) some of the greenhouses surveyed in this study, (B) Cultured with economic plants, (C) Cultured with ornamental plants, (D, E) The infestation of *Xeropicta krynickii* and *Monacha obstructa* on some plants.

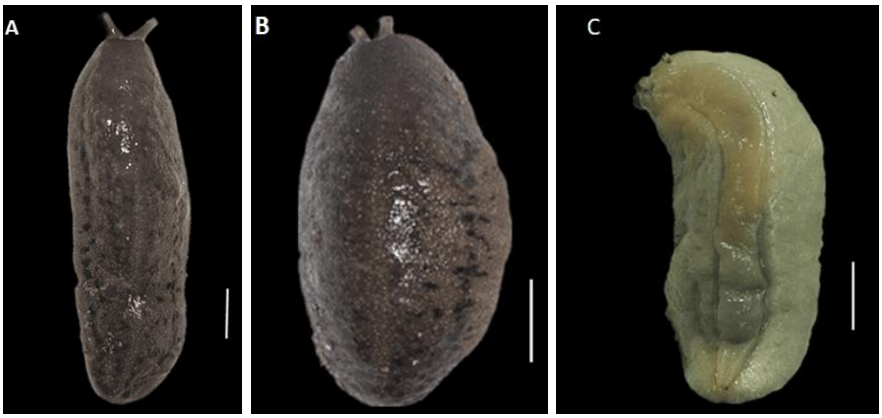

Plate (2): *Veronicella cubensis*; (A) Dorsal view (relaxed), (B) Contracted, (C) Ventral view. [Scale bar 1cm].

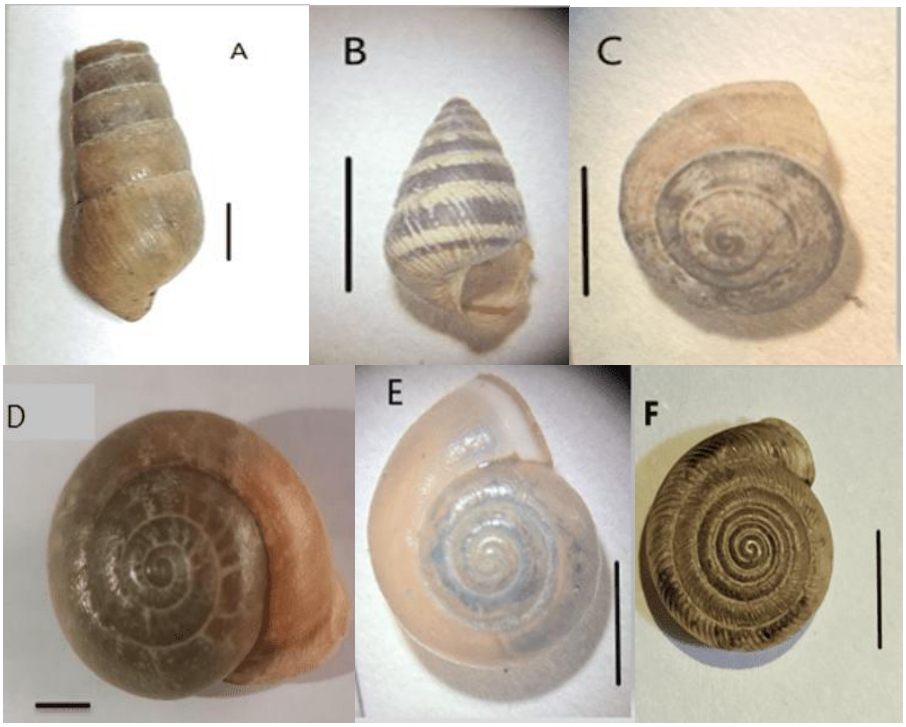

Plate (3): Snails prevalent in greenhouses during the current study; (A) *Rumina decollata*, (B) *Cochlicella barbara*, (C) *Xeropicta krynickii*, (D) *Eobania vermiculata*, (E) *Monacha obstructa* (F) *Polygyra cereolus.* [Scale bar 5mm].

DISCUSSION

In Iraq, a few studies have been conducted to survey and identify the land snails, with some species observed infesting agricultural areas (Al-Doori *et al*., 2018; Jihad and Ali, 2021), while the current study is then the first report on molluscs found exclusively in covered culture within the country.

The results of our study reveal a list of seven species of terrestrial gastropods. These species can be divided into two groups: the first group includes native species that are common in Iraqi fields, such as *Xeropicta krynickii* and *Monacha obstructa*. The second group includes non-native species that have been recorded in recent years as part of the country's malacofauna including *Eobania vermiculata*, *Cochlicella barbara*, *Polygyra cereolus*, *Rumina decollata* and the newly reported *Veronicella cubensis*. High population densities of *V. cubensis* were observed infesting several species of ornamental plants in Baghdad. The introduction of *V. cubensis* into new areas typically occurs via plant material (McDonnell *et al*., 2008), which is likely the cause of its introduction into Iraq as well.

All ornamental plant houses were infested because they were not controlled with pesticides. In contrast, economic plants were treated with pesticides and thus were nearly free of infestation. The family Geomitridae was the most diverse, with two species recorded, while the species *Monacha obstructa* was the most frequent species, found in three locations on a wide range of plants.

CONCLUSIONS

Based on our findings on the infestation rate of gastropods in greenhouses in Iraq, it can be concluded that land snails represent important greenhouse pests. In greenhouses, both commonly encountered native species like *Monacha obstructa* and introduced aliens like the newly recorded slug species *Veronicella cubensis* can be found. Effective management of these species is required, including the use of molluscicides to prevent further spread and infestations.

CONFLICT OF INTEREST STATEMENT

The authors explain no conflict of interest concerning the work in a manuscript.

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Bull. Iraq nat. Hist. Mus.
(2025) 18 (3): 565-576.

مسح لبطنية الأقدام في البيوت المحمية في العراق

هبه محمد جهاد و نور حسين يوسف

مركز بحوث ومتحف التاريخ الطبيعي، جامعة بغداد، بغداد، العراق.

الاستلام: 2024/6/10، المراجعة: 2025/2/13، القبول: 2025/2/16، النشر: 2025/6/20

الخلاصة

توفر الظروف الرطبة والدافئة في البيوت المحمية بيئة ممتازة لمعيشة الآفات، وبالتالي فهي توفر وسطًا مثاليًا لدخول الكائنات الغريبة. تعتبر الرخويات من أهم الآفات التي تصيب البيوت المحمية المغطاة بالبلاستيك، ولغرض تحديد وتصنيف أنواع الرخويات الموجودة داخلها والإبلاغ عنها، تم مسح 23 بيتاً محميا في العراق للفترة من آذار 2023 إلى نيسان 2024، وجد 11 مصابة بقواقع، وتم جمع 158 عينة وتم التعرف عليها مظهريا إلى سبعة أنواع:

Monacha obstructa (Pfeiffer, 1842), *Eobania vermiculata* (O.F. Müller ،1774) ، *Xeropicta krynickii* (Krynicki ،1833) ،*Rumina decollata* (Linnaeus ،1758) , *Polygyra cereolus* (Mühlfeld, 1818), *Cochlicella barbara* (Linnaeus, 1758،)

اضافة الى البزاق *Veronicella cubensis* (L.Pfeiffer, 1840) الذي يسجل لأول مره في الدراسة الحالية. ومع قلة المعرفة عن آفات الرخويات في العراق، فإن البيانات المقدمة حاليا ستوفر معلومات أساسية للعديد من الأغراض الزراعية.