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# First record of Scuttle fly, *Megaselia* (M) *scalaris* (Loew) (Diptera: Phoridae) as a parasitoid of Sunn pest, *Eurygaster integriceps* Puton (Hemiptera: Scutelleridae) from Iran

Laleh Ebrahimi<sup>1\*</sup> , R. Henry L. Disney<sup>2</sup>, Alireza Haghshenas<sup>3</sup>, Ebrahim Gilasian<sup>4</sup>, Masood Amir-Maafi<sup>5</sup> and Shahram Shahrokhi Khaneghah<sup>5</sup>

## Abstract

The Scuttle fly, *Eurygaster integriceps* Puton (Hemiptera: Scutelleridae) is a key pest of wheat and barley. The pest is univoltine and migrates from wheat fields following harvest to high elevations; then, the following spring it moves back to the fields. Natural enemies may have an important role in decreasing the population's level in overwintering sites. In the present study, adults of *E. integriceps* were collected from overwintering sites in Isfahan province, Iran, in October 2022 and transferred to the laboratory. One week after sampling, dead adults were isolated and divided into three groups: one group was dissected under a stereomicroscope, and parasitoid larvae were extracted from the cadavers; the second one was incubated in Petri dishes sealed with parafilm, individually for four weeks, and emerged pupae were collected; and the third group was incubated in the closed boxes, and emerged flies were collected for fixing and identification. Assessment of dissected adult *E. integriceps* under a stereomicroscope revealed that the insect was parasitized with *Megaselia scalaris* (Loew) (Diptera: Phoridae) larvae. Per adult, up to 13 larvae were found inside *E. integriceps*. The last instar larvae were pupated outside the *E. integriceps* body. This study is a new record of *M. scalaris* as a parasitoid of *E. integriceps* in Iran.

**Keywords** Sunn pest, *Eurygaster integriceps*, *Megaselia scalaris* parasitoid, Overwintering site

\*Correspondence:

Laleh Ebrahimi  
ebrahimi.laleh@gmail.com

<sup>1</sup> BioControl Research Department, Iranian Research Institute of Plant Protection, Agricultural Research, Education and Extension Organization (AREEO), Yemen Street, Tehran 1985813111, Iran

<sup>2</sup> Department of Zoology, University of Cambridge, Cambridge, UK

<sup>3</sup> Plant Protection Research Department, Isfahan Agricultural and Natural Resources Research and Education Center, AREEO, Isfahan, Iran

<sup>4</sup> Insect Taxonomy Research Department, Iranian Research Institute of Plant Protection (IRIPP), Agricultural Research, Education and Extension Organization (AREEO), Tehran, Iran

<sup>5</sup> Sunn Pest Research Department, Iranian Research Institute of Plant Protection, Agricultural Research Education and Extension Organization (AREEO), Tehran, Iran

The Scuttle fly, *Eurygaster integriceps* Puton (Hemiptera: Scutelleridae) is an economically important insect pest of wheat and barley in West and Central Asia, Eastern Europe, and North Africa (Davari & Parker 2018). Estimated yield loss caused by high populations of *E. integriceps* reaches 20–30% in barley and 50–90% in wheat and can reach 100% in the absence of control actions (Davari & Parker 2018). Natural enemies have the greatest effect among the factors restraining the Sunn pest population (Iranipour et al. 2011). Several general and specialized natural enemies attack different life stages of *E. integriceps*. Hymenopteran egg parasitoids, especially those of the genus *Trissolcus* sp. (Scelionidae) and tachinid

flies (Diptera: Tachinidae) as parasitoids of adults and nymphs, are the most important parasitoids of *E. integriceps* (Davari & Parker 2018).

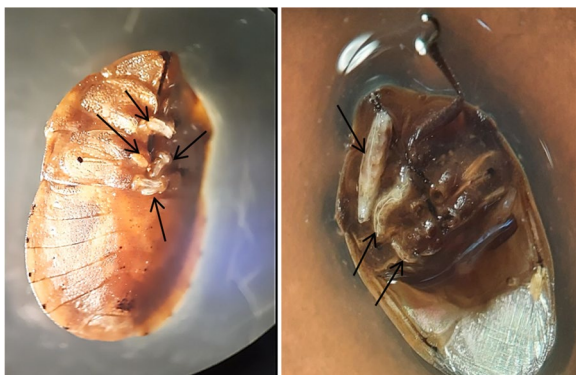
Phoridae have more than 4000 world species, and the largest genus in this family is the genus *Megaselia* with over 1700 species worldwide (Namaki-Khameneh et al. 2021). *Megaselia scalaris* (Loew) (Diptera: Phoridae) is an omnivorous cosmopolitan species, whose larvae occur in a large variety of environments and ecological niches and develop on living and decayed materials with plant or animal origin (Namaki-Khameneh et al. 2021). Ever more, larvae of *M. scalaris* can become facultative predators, parasitoids, or animal and human parasites (Disney 2008). This species has medical and forensic importance because of its role in animal and human myiasis and its colonization of human corpses (Varney and Noor 2010). Recently, the use of *M. scalaris* in genetics and developmental biology studies has increased (Mukherjee et al. 2019). Moreover, parasitism of some insect species of agronomic and medical importance from different orders including Hymenoptera, Hemiptera, Orthoptera, Mantodea, Lepidoptera, Diptera, and Coleoptera has been reported by El-Hawagry et al. (2021).

*Megaselia scalaris* has been reported from Iran as a button mushroom (*Agaricus bisporus*) pest (Zamani et al. 2005), as a parasitoid of the Iranian honey bee, *Apis mellifera meda* (Hymenoptera: Apidae) (Abdi-Goodarzi et al. 2013), human Urogenital Myiasis (Ghavami and Djalilvand 2015) and ectoparasite of larvae of *Polyphylla adspersa* (Coleoptera: Melolonthidae) (Karimi et al. 2019).

The aim of this study was to report *M. scalaris* parasitizing *E. integriceps*, as a new host in Iran. Adults of *E. integriceps* were collected from Jozdan, Isfahan province, Iran (52°72'N, 35°97'E, and alt. 2250), during October 2022. The insects were transferred to the laboratory and

kept in closed boxes with ventilated lids at  $25 \pm 1$  °C and RH=75%. One week after sampling, dead adults were collected from the boxes; divided into three groups. One group was dissected under an Olympus SZH stereomicroscope and parasitoid larvae were extracted from the cadavers. The second group was incubated in Petri dishes sealed with parafilm, individually for four weeks, and emerged pupae were collected. The third group was incubated in the closed boxes, and emerged flies were collected. The collected insects were fixed in 90% ethanol and used for identification.

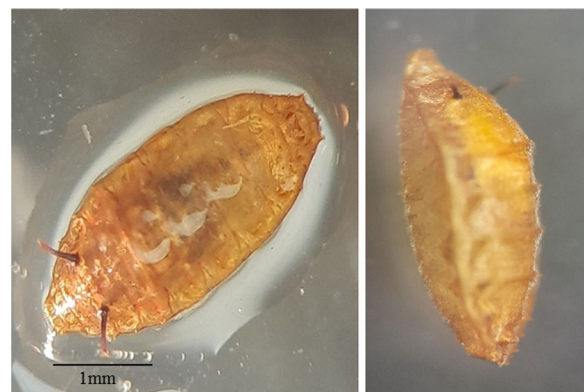
Examination of adult *E. integriceps* under a stereomicroscope revealed insect parasitized with *M. scalaris* larvae. More than one larva in the body of each dead *E. integriceps* (Fig. 1) was found (gregarious parasitoid). Up to 13 larvae were found inside the body of one adult *E. integriceps*. The larvae inside the body were in different sizes ranging from 1 to 4.5 mm in length and 0.2–1 mm in width (Fig. 2). The last instar larvae pupated outside the *E. integriceps* body (Fig. 3), and the adults emerged from the puparium (Fig. 4) after about 14 days under laboratory conditions. Females were larger than males (Fig. 5).



**Fig. 1** Parasitized adult *Eurygaster integriceps* with *Megaselia scalaris* larvae in different sizes inside the body (*M. scalaris* larvae are shown with small black arrows)



**Fig. 2** Different larval stages of *Megaselia scalaris* extracted from adult *Eurygaster integriceps* cadaver



**Fig. 3** Pupae of *Megaselia scalaris* parasitized *Eurygaster integriceps*



**Fig. 4** Puparium of *Megaselia scalaris* after adult eclosion



**Fig. 5** Adult female and male *Megaselia scalaris* parasitized *Eurygaster integriceps*

This study represents a new record of *M. scalaris* as a parasitoid of *E. integriceps*. Parasitism of some insect species from different orders has been reported. However, reports on hemipteran insects are limited to a few species including *Triatoma brasiliensis* (Reduviidae) (Costa et al. 2007), *Palomena prasina* (Pentatomidae) (Özdemir and Tuncer 2020), and *Nezara viridula* (Pentatomidae) (El-Hawagry et al. 2021). In agreement with our results, in all the mentioned studies, the adult hemipterans were parasitized and more than one larva of *M. scalaris* was found inside the parasitized hemipteran hosts. However, El-Hawagry et al. (2021) reported more than 40 larvae of *M. scalaris* from one parasitized *N. viridula*.

Over 15 million hectares in Iran, Turkey, Iraq, Syria, Lebanon, Jordan, Israel, Kazakhstan, Uzbekistan, Kyrgyzstan, Tajikistan, Afghanistan, and Pakistan is infested by the Sunn pest (Davari & Parker 2018). In infested areas, the main control strategies have heavily relied on chemical insecticides (Alizadeh et al. 2022). Considering the overuse of insecticides against *E. integriceps*, and the problems related to the pest resistance, environmental

pollution, and consequently, human health hazards, reconfirm the importance of seeking alternative pest control strategies, especially with the emphasis on natural enemies. *M. scalaris* was reported in the present study, as a parasitoid of *E. integriceps*, although further works are expected to be done on the relationship between *M. scalaris* and *E. integriceps*, especially the rate of natural parasitism in the overwintering sites of *E. integriceps*, as well as on the biological parameters of the parasitoid species.

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#### Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

#### Declarations

##### Ethics approval and consent to participate

Not applicable.

##### Consent for publication

Not applicable.

##### Competing interests

The authors declare that they have no competing interests.

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