



## Distinguish Behavioral characteristics of *Diasemiopsis ramburialis* (Duponchel, 1833) and *Nomophila noctuella* (Denis & Schiffermuller, 1775) (Lepidoptera: Crambidae) on *Azolla* spp.

Atousa Farahpour-Haghani\*, Mahdi Jalaeian

Rice Research Institute of Iran (RRII), Agricultural Research, Education and Extension Organization (AREEO), Rasht, Iran

\*: corresponding Author Email: hpapilion@gmail.com

Atousa Farahpour-Haghani: <https://orcid.org/0000-0002-6158-4527>, Mahdi Jalaeian: <https://orcid.org/0000-0002-1965-9695>



### Abstract

It is generally accepted that biological invasions have major ecosystem impacts and create new types of interaction between local and exotic species. *Azolla* spp. invasion caused different interactions between local and exotic species in the northern region of Iran. *Diasemiopsis ramburialis* and *Nomophila noctuella* are two spilmelinae moths found feeding on *Azolla* spp. in these regions. They have overlapping feeding periods on *Azolla* spp. and immature stages would be confused easily. *N. noctuella* was recorded as a polyphagous and pest species while *D. ramburialis* had no other reported host plant beside *Azolla* spp., therefore, distinguishing these species from each other was so important for anyone who was working on *Azolla* spp. management in these Areas. Behavioral characteristics of both species were studied for five years in the laboratory and natural habitats. The results indicated that despite the similarities between immature stages, there are some distinctive behavioral characteristics that would be useful for primary identification of each species in the field. *D. ramburialis* larvae constructed well-shaped and strong shelters, and produced more silken webs and remained in the shelter most of the time. In addition pupation occurs near the feeding site in this species. *N. noctuella* larvae have wandering behavior and prefer to move in margins, therefore in this species, pupation occurs far from the feeding site. These results indicated that *D. ramburialis* is more adapted to feed *Azolla* spp. and *Azolla* spp. are main host plants for this species while *N. noctuella* chose them randomly.

**Key words:** Spilmelinae, *Azolla* spp., Behavioral characteristic

### Introduction

Spilmelinae (Guenée, 1854) is the largest subfamily of Crambidae; (6). In recent years, it has been indicated that *Diasemiopsis ramburialis* (Duponchel, 1833) and *Nomophila noctuella* (Denis and Schiffermuller, 1775) (Fig. 1) from spilmelinae, feed on *Azolla* spp. in the northern region of Iran and have overlapping feeding periods (4&5). *Diasemiopsis ramburialis* is a cosmopolitan species (2) and *Azolla* spp. are known as the first host plants of this moth (5). *Nomophila noctuella* is mainly separated in the old world (9). This moth is known as a polyphagous species and a pest for some crops (10&2) The larvae of both species are non-aquatic and have shelter making behavior. The specific objective of this paper is to compare behavioral characteristics both species in order to recognize each species during their overlapping feeding period.

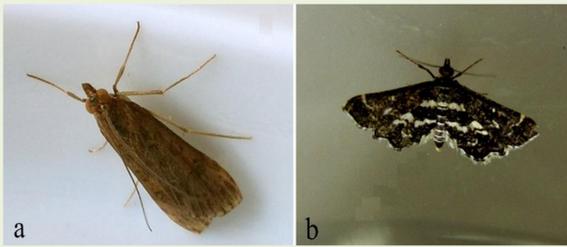


Figure 1- Adults (a: *Nomophila noctuella*, b: *Diasemiopsis ramburialis*)

### Material and methods

Laboratory colonies were established by collecting larvae from *Azolla* spp. from September to November in 2013 to 2018. we used disposable plastic containers (18×13 cm, diameter by height) as mating chamber and plastic boxes (24×17×10 cm, length by width by height) as rearing chambers, each covered with transparent cellophane with small holes in the cellophane for ventilation. All chambers were kept in 25–27 ° C and 16: 8h (L: D) photoperiod. In mating chambers a pair adults, were released in each chamber upon emergence. For rearing experiments first or second instar larvae were released in rearing chambers (20 individuals in each box). Water and food materials were renewed once in three days.

### Results and Discussion

#### Results

- 1- *D. ramburialis* and *N. noctuella*, feed on *Azolla* spp. in the northern region of Iran..
- 2- Newly hatched larvae of both species built shelter by binding *Azolla* spp. leaves together and *D. ramburialis* larvae produced more webs (Fig. 2).
- 3- *D. ramburialis* larvae move in distinctive corridors that made by silken webs among the *Azolla* spp. leaves. (Figs. 2b1&b2). They rarely left these corridors and pupation always occurred in these shelters (Figs. 3b1&b2).
- 4- *N. noctuella* the larval pathway was under the *Azolla* spp. leaves and larvae just bind over leaves to make a union layer. As the result, they produced fewer amounts of the webs and the larvae pathway were not as clear as *D. ramburialis* (Fig. 2). In addition, *N. noctuella* larvae wandered on *Azolla* spp. regularly and leave frass near the pathways (Fig. 2a1) and due to wandering behavior of larvae pupation occurred in places that were somewhat far from feeding sites (Figs. 3a1&a2).
- 5- It is indicated *N. noctuella* larvae prefer to move in the feeding site margins (Figure 4).

#### Discussion

Insects adapt with their host plant and mediate their feeding behavior and strategy in response to host plant characteristics (1). Therefore making strong shelters in *D. ramburialis* that provide more protection for the larvae, would be an adaptive behavior in response to feed on an aquatic host plants. In addition, non-wandering behavior of the larvae which led to pupation in concealed sites would be another beneficial adaptive behavior that protects the larvae and pupa from predators in aquatic ecosystems. These results indicate that *D. ramburialis* is adapted to feed on the *Azolla* spp. perfectly. Unlike the *D. ramburialis*, *N. noctuella* is a polyphagous species (2). This moth can feed on many host plants and its feeding behavior on *Azolla* spp. indicates that it is not so adapted to feed on the aquatic plants. Despite the shelter making behavior of larvae, shelters on *Azolla* spp. were not so strong and wandering behavior of the larvae exposed larvae and pupa to aquatic predators easily. Therefore the larvae preferred to move near the margins. However due to polyphagous behavior of the larvae and high abundance of *Azolla* spp. this species chose to feed on the new host plant. Beside *D. ramburialis* and *N. noctuella*, there are other fern-feeding group of moths from form Heliiothelinae (Amsel, 1961) in crambidae (7). Therefore, feeding on *Azolla* spp. in *N. noctuella* could be based on phylogenetically connections as well

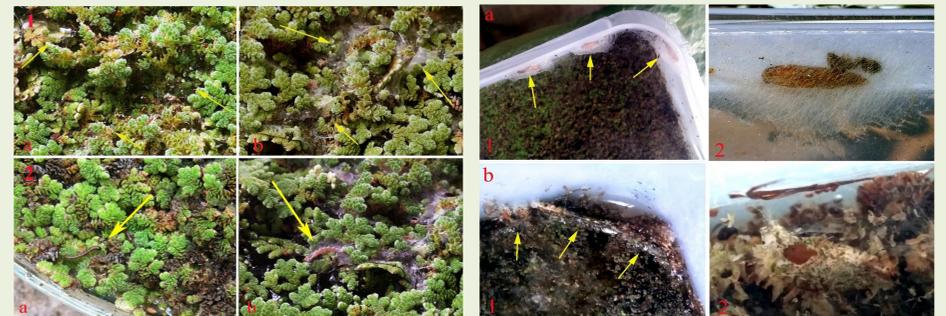


Figure 2- amount of produced webs (1) and larvae pathway(2) (a: *Nomophila noctuella*, b: *Diasemiopsis ramburialis*)

Figure 3- Pupation site (1) and pupa (2) (a: *Nomophila noctuella*, b: *Diasemiopsis ramburialis*)



Figure 4- *Nomophila noctuella* larvae pathway in margins

### Conclusion

*Azolla* spp. invasion caused different interactions between local and exotic species in the northern region of Iran. *Diasemiopsis ramburialis* and *N. noctuella* found feeding on *Azolla* spp. in the northern region of Iran. There was no record of these species or their biology on *Azolla* spp. worldwide. Studies indicated that they have overlapping feeding periods on *Azolla* spp. and would be confused easily. Since *N. noctuella* was recorded as a polyphagous and pest species it was important to be distinguished from *D. ramburialis*. Behavioral studies indicated that compared with *N. noctuella*, *D. ramburialis* is more adapted to feed on *Azolla* spp. Therefore, *Azolla* spp. could be main host plants for this species. Much more studies need to confirm this hypothesis but it is sure that *D. ramburialis* and *N. noctuella* would be important biotic resistance factors for *Azolla* spp. in the northern region of Iran.

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