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Coexistence of *Henosepilachna elaterii* (Rossi, 1794) (Coleoptera Coccinellidae) on *Citrullus colocynthis* Schrad. (Cucurbitaceae) around the water dam of El Outaya (Biskra, Algeria)

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ABSTRACT Morphological studies (Total length from apical margin of clypeus to apex of elytra, width, body area and wing length) were carried out on the fourth larval instar, pupa and adult (male and female) of *Henosepilachna elaterii* (Rossi, 1794) (Coleoptera Coccinellidae) sampled from a Cucurbitaceae plant (*Citrullus colocynthis* Schrad.), which grow around the dam "Fountains of Gazelles" in Biskra (Algeria). The fourth instar larva and pupa measured 8.55 ± 0.20 mm and 2.56 ± 0.26 mm; 7.38 ± 0.36 mm and 4.81 ± 0.36 mm; length and width respectively. Adult beetles feeding on fresh leaves were hemi-spherical in shape and red ferruginous in color with 12 black spots on the elytra. Females measured 6.97 ± 0.25 mm in length and 5.37 ± 0.34 mm in width, while males were 6.17 ± 0.31 mm in length and 4.80 ± 0.37 mm in width. Duncan's multiple range tests allowed us to classify specimens in increasing order of area as follows: 4th instar larvae 20.29 ± 0.15 mm^2, adult male 26.41 ± 2.52 mm^2, pupa 28.14±0.31 mm^2 and adult female 31.73 ± 1.84 mm^2. Moreover, the female wing was longer with a value of 10.07 ± 0.54 mm compared to the male, which recorded 8.72 ± 0.60 mm in length. Both adults and larva were serious pests of *Citrullus colocynthis* which resulted in skeletonisation of leaves.

KEY WORDS *Citrullus colocynthis*; *Henosepilachna elaterii*; Larvae; Phytophagous.

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INTRODUCTION

Ladybirds (Coleoptera Coccinellidae) are distributed in all the continents, although several authors (Fürsch, 1996; Kovar, 2005) situate them in the tropics and sub-tropics. Others claim that for each continent there is a specific fauna of ladybirds (Belicek, 1976). In Algeria, studies on the biodiversity of ladybirds are very rare. The only reference works that cover the Algerian territory these days are those of Djouhri (1994) and Saharaoui et al. (2014), who are interested in this group of insects by carrying out an inventory in different Algerian agroecosystems.

The family Coccinellidae Latreille, 1807, has about 5000 species spread around the world and it is subdivided into six subfamilies: Chilocorinae, Coccidulinae, Coccinellinae, Epilachninae, Scyminae, Sticholotidinae. Adults are small (1 to 10 mm), hemispherical and brightly colored. Coccinellidae are very close to Endomychidae Leach, 1815, whose larvae live in mushrooms, mainly those of the genus *Lycoperdon* Pers. (Seago et al., 2011). If some genus of Coccidulinae are mycophagous, consuming conidia molds leaves, most are carnivores

feeding on aphids, mealybugs, whiteflies or mites (Bagal & Trehan, 1945).

The Epilachninae are phytophagous and are characterized by multi-serrated mandibles and eyes more distant than the bases of the antennas (Samways et al., 1997). Larvae gnaw on the leaf limb, without perforating it (Bonnemaison, 1962). The sub-family, distributed throughout the planet and well represented in South America, has in Western Europe, some species, including pests, to monitor (Roy et al., 2012).

Considering the relationships that exist between ladybirds phytophagous and the plant species, we carried out surveys and samplings on a plant species of the Cucurbitaceae family (*Citrullus colocynthis* Schrad.) and on the specie of Epilachninae associated with this plant: *Henosepilachna elaterii* (Rossi, 1794).

The ladybird *H. elaterii*, named Melon ladybird beetle or Twelve-spotted melon beetle, has a very beautiful ferruginous red color, a little tawny; the body is entirely covered with a fine golden pubescence (Essig, 1958). In addition, twelve black spots of fairly large size, sometimes welded together (individual variations), are regularly distributed on the elytra; the four previous points are arranged in a straight line (Kaygin & Kaptan, 2017). It is a pest in the Mediterranean Basin, in Corsica and Italy, as well as in North Africa and southern Russia (Bonnemaison, 1962). In Oriental Asia is substituted by *H. pusillanima* (Mulsant, 1850) with the same behavior (Dieke, 1947).

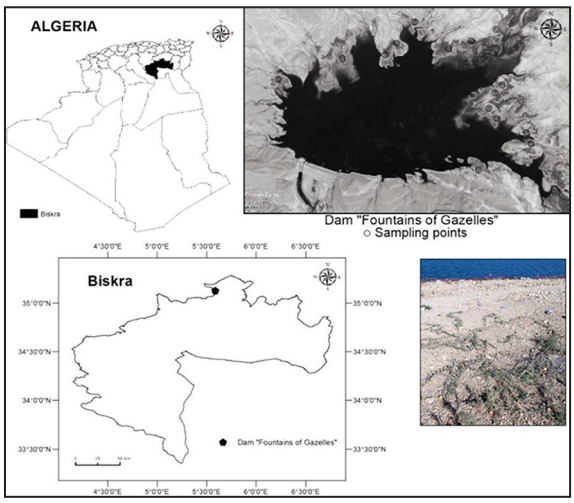

Figure 1. Study area and location of sampling sites (El Outaya, Biskra, Algeria).

The host plants are various cucurbits (Cucurbitaceae), like melons, water melons, snake melons and gourds (Bayhan & Ölmez-Bayhan, 2017). Pupation takes place on the leaf or on rocks. There are 2 to 3 generations per year. Adults overwinter under plant debris until March or April. They gnaw the shoots and then the leaves, under which the females will lay, in packs of 30 to 50, yellow-light eggs, 1.75 to 2 mm in length. Dirty yellow larvae, 8 to 9 mm in size, will hatch a few days later and begin to eat the leaves, leaving bites in parallel (El-Abdin & Siragelnour, 1991).

In this investigation, we will study the morphometry of this species after having evaluate its distribution around the dam "Fontain of Gazelles" in Biskra (Algeria) through several observations and samplings.

MATERIAL AND METHODS

Schematic map and sampling sites

The study on morphometric parameters of a phytophagous coccinellidae species (*H. elaterii*) was carried out at the pedagogic laboratory of the Department of Ecology and Environment, University of Batna 2, Algeria.

To undertake this study, we have made surveys around the dam "Fountains of Gazelles" in Biskra (Algeria) (Latitude: 35°7'48.50"N; Longitude: 5°35'14.07"E; Elevation: 377 m), the surface is about 5 km^2 and the stored water is slightly saline (Fig. 1). Investigations were led during the year 2017, essentially between the beginning of September and the end of November. We adopted the method used by Iperti (1965), which consists in a stratified sampling.

The method used for mapping species distributions corresponds to the real distribution area. Georeferenced distribution maps were realized by GIS software (ArcGIS 10.3). Geographical positions were recorded using a Magellan eXplorist 200 GPS Receiver.

Specimens were sampled from 15 plants of *Citrullus colocynthis*, which grow on the perimeter of the dam and at its proximity up to 10-15 meters (Fig. 1). The specimens of *H. elaterii* were cautio-usly handpicked, placed in Petri dishes and transported to the laboratory to be used in morphological studies.

Morphometry

Twenty specimens from each development stage were used. Morphological studies (total length from apical margin of clypeus to apex of elytra, width, body area and wings length) were carried out on the fourth larval instar, pupa and adult (male and female) of *H. elaterii*. Measurement of wing length has been applied only on adults (male and female). Samples were recorded by photography (using Samsung HD camera ST66, 16.1 megapixels) and measured using Digimizer software (Figs. 2-5). A scale bar was added.

Statistical analysis

The mean length, width and area of all stages of *H. elaterii* (n = 20) were calculated using Excel 2016. The data were statistically treated by Fisher's analysis of variance (ANOVA). Duncan's multiple range tests were performed to determine significant difference between means at a significance level of 5% using Statistical Analysis System software version 9.0 (SAS 2002).

RESULTS AND DISCUSSION

The 4th instar larvae were very active, with black spines all over the body and fed voraciously and their abdomen appeared greenish due to food material inside. The average length and width of 4th instar larvae were (8.55 ± 0.20 mm) and (2.56 ± 0.26 mm) respectively.

Pupa was the non-feeding quiescent stage. It was rectangular and shining yellow with (7.38 ± 0.36 mm) in length and (4.81 ± 0.36 mm) in width, with spines all over the body and bearing last larval skin as pupal case and two anterior black spots then moulted to adult.

Adult beetles feeding on fresh leaves were circular, hemi-spherical in shape and red ferruginous in color with later 12 black spots on the elytra. Females were bigger and darker than males. Indeed, Males were (6.17 ± 0.31 mm) in length and (4.80 ± 0.37 mm) in width. Contrariwise, adult females were (6.97 ± 0.25 mm) in length and (5.37 ± 0.34 mm) in width (Table 1). Moreover, spot areas in adult female were larger with light color perimeter.

Values followed by different letters in the same column are significantly different at $p < 0.05$.

Figures 2, 3. *Citrullus colocynthis* colonized by the 4th larval instar (Fig. 2), and the adult stage of *Henosepilachna elaterii* (Fig. 3). Figures 4, 5. *H. elaterii*: pupa (Fig. 4) and fourth instar larva (Fig. 5). Figure 6. Defoliation on *Citrullus colocynthis* colonized by *H. elaterii.*

Life stage	Body size		
	Length (mm)	Width (mm)	Area (mm^2)
4th larval instar	8.55 ± 0.20^{A}	2.56 ± 0.26^{C}	20.29 ± 0.15^{D}
Pupa	7.38 ± 0.36^{B}	4.81 ± 0.36^{B}	28.14 ± 0.31^{B}
Adult			
Male	6.17 ± 0.31^{C}	4.80 ± 0.37^{B}	26.41 ± 2.52^{C}
Female	6.97 ± 0.25^{D}	5.37 ± 0.34^{A}	31.73 ± 1.84^{A}
p	*<0.0001*	*<0.0001*	*<0.0001*

Table 1. Main results of the ANOVA, sample sizes (Mean ± SD) for each development stage included in this study with Duncan's multiple range tests (n = 20).

For the body area parameter, Duncan's multiple range tests allowed us to classify specimens in increasing order as follows: 4th instar larvae (20.29 ± 0.15 mm^2), adult male (26.41 ± 2.52 mm^2), pupa (28.14 ± 0.31 mm^2) and adult female (31.73 ± 1.84 mm^2) (Table 1).

According to Table 1, the female wing was longer with a value of (10.07 ± 0.54 mm) compared to the male which recorded (8.72 ± 0.60 mm) in length. The pest caused the netting, curling and drying of leaves and the final defoliation (Fig. 6).

The present investigation also shows the consequences that *H. elaterii* made on *C. colocynthis* leaves. Studies on biology and life cycles of *H.*

elaterii on different watermelon cultivars (Bayhan & Ölmez-Bayhan, 2017) have shown similar results in their morphology as observed in the present study, but variations were found in the size of each stage.

Information gathered on life cycle parameters such as duration of the life cycle, size and longevity of each instar, egg laying pattern and nature of the pest is helpful for providing information on population build up, identification of the biotype and their management. Variations observed by different investigators could be attributed to differences in host plant, change in climatic conditions, locality and other environmental factors (Borgia & Miranda, 2016).

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