Online ISSN: 2299-9884
Polish Journal of Entomology 90(3): 145–151 (2021) DOI: 10.5604/01.3001.0015.3169

First record of *Orsodacne altra* (Coleoptera: Orsodacnidae) and *Cyrtosus cyanipennis* (Coleoptera: Malachiidae) associated to *Dactylopius opuntiae* (Hemiptera: Dactylopiidae) in Morocco

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Abstract: Recently *Dactylopius opuntiae Dactylopius opuntiae* (Cockerell, 1896) (Hemiptera: Dactylopiidae) has caused enormous damage in several production areas of cactus in Morocco. The spread of infestation by this scale pest is fast and unpredictable, and consequently, the destruction of large areas planted with cactus in several regions of the Kingdom. In aim to discover natural enemies that have the capacity and potential to be used as mealybug predators, a team of researchers have conducted surveys in cactus production areas. In January 2020 two unidentified Coleoptera species were observed associated to *D. opuntiae* in an infested cactus crop in El-Gharbia locality. The observed species were identified as *Orsodacne altra* (Ahrens, 1810) and *Cyrtosus cyanipennis* (Erichson, 1840). The current study represents the first register of these two genera associated to cactus mealybug in Morocco.

Keywords: *Dactylopius opuntiae, Orsodacne altra, Cyrtosus cyanipennis*, Morocco

Introduction

Dactylopius opuntiae (Cockerell, 1896) (Hemiptera: Dactylopiidae) is an invasive and devastating supping scale pest of cactus in many areas worldwide where cactus is a crop. This cochineal was first detected in Morocco in fall 2014 during sampling in the cactus crop in the Sidi Bennour region. It was identified as wild cochineal of prickly pear by Bouharroud *et al*. (2016). Currently, *D. opuntiae* is considered the most damaging pest of cactus in Morocco. This hemipteran feeds directly on the plant causing chlorosis and premature dropping of cladodes and fruits. Severe infestations inferior to 75% of the cladode surface can result in wilting and death of the plant (Vanegas-Rico *et al*. 2016). Since its appearance in Sidi Bennour – Doukkala, Morocco, it caused enormous damage in several areas of the cactus. The spread of infestation by this pest is fast and unpredictable, and consequently, the destruction of large areas planted with cactus in several regions of Morocco, in particular in Doukkala, Rhamna, Bengrir, Abda, Azilal, Benimellal, Taourirt, Haouz, and Chaouia where tens of thousands hectares of cactus are totally destroyed, causing enormous socio-economic and environmental losses (El Aalaoui *et al*. 2020). Similar cases have been declared by Lopes *et al*. in 2009, when *D. opuntiae* attacked a fodder species of cactus, *Opuntiae fiicus indica,* in Brazil where 100 000 ha were damaged, estimated at about 25 million USD. Also, in Mexico, the harm to nopalitos and fruit (young cladodes) caused by *D. opuntiae* resulted in higher production costs and lower yields (Portillo & Vigueras 2006). In the Mediterranean area, Dactylopiidae was reported in Europe and Middle East (Bouharroud *et al*. 2016).

Many arthropod species were found associated to *D. opuntiae* and other scale pests include in Dactylopiidae family around the world (Vanegas Rico *et al*. 2010) including Coleoptera (Coccinellidae), Diptera, and Lepidoptera. In Brazil, several groups of Coleoptera of witch the genera *Exochomus* Redtenbacher, 1843, *Chilocorus* Leach, 1815,

Cryptolaemus Mulsant, 1853, *Hyperaspis* Chevrolat in Dejean, 1837, and *Scymnus* Kugelann, 1794 have been consistently observed associated with colonies of *D. opuntiae* (Baskaran *et al*. 1999, Adalma-Aguilera *et al*. 2005, Vanegas-Rico *et al*. 2010, Barbosa *et al*. 2014). After the first detection of *D. opuntiae* in Morocco surveys were conducted in different cactus production areas to find the species with potential as predatory organisms and in January 2020 two unidentified Coleoptera species belonging to genera *Orsodacne* and *Cyrtosus* were observed in the cactus crop associated to *D. opuntiae* colonies in El-Gharbia locality (Sidi Bennour, Morocco). The orsodacne and cyrtosus fauna of Morocco is still unknown. The goal of this manuscript is to report the identification of these Coleoptera.

Material and Methods

Study area

The collected specimens were found associated to *D. opuntiae* colonies in El-Gharbia (32°37'48" N, 8°42'0" W) in the Sidi Bennour region (120 km north-west of Marrakech), Morocco. The estate is in the semi-arid ecological zone. The rainfall varies from 112.6 to 607 mm/year and the annual average of the last 30 years is 330 mm. Temperature varies from -1°C (December–January) to 40–45 °C (July–August). The climate data were collected using iMetos electronic weather station (Pessl Instruments, GMBH).

Specimen collection, preparation and identification

Sampling of adult Coleoptera was conducted in January 2020. The insects were collected by sweep sampling, and methods based upon visual encounters, such as aspiration and handpicking. The collected insects were transferred into tubes containing alcohol 90% as a killing agent and carefully studied under a binocular loupe (Motic). To obtain an accurate identification of the specimens, the males and females genitalia were extracted. After soaking the specimen from the pin in water for one night, the abdomen was separated from the body by lifting it up between the two elytra with fine forceps. The abdomen was soaked in an oversaturated solution of 10% KOH for 10–30 minutes as a pretreatment. The time of pretreatment depended upon sclerotization rung for each species. In this solution, the abdomen's upper side layer was gently excluded from the underside layer with two needles, by tearing them apart at two sides. After pretreatment, the species abdomens were washed in water several times. The abdomen could then easily be laid open and the genitalia is taken out. The identification of the specimens was done by the following keys: Mohr (1966), Gruev & Tomov (1984, 1986), Lopatin (1984), Warchalowski (1991, 1993, 1994, 2003), Marshall (1954), and Li & Liang (2018). Voucher specimens of species identified were labeled from which they originated and deposited at the laboratory of entomology at the National Institute of Agricultural Research (INRA-Morocco).

Results

The Coleoptera were identified as *Orsodacne altra* (Ahrens, 1810) (Fig. 1) and *Cyrtosus cyanipennis* (Erichson, 1840) (Fig. 2).

Descripition of *Orsodacne altra* adults

The *Orsodacne altra* adults were elongate 5–7 mm long and 3–5 mm wide. Head is broad as pronotum. The pronotum is convex and black and narrower than the base of elytra. Eyes, scutellum, and vertex were black, and elytra with stripes black and yellow with black spots. Antennae were filiform with 11 antennomeres and abdomen with 5 distinct ventrites. The observation of external female genitalia showed that the components of the ovipositor are sclerotized with clear boundaries (Fig. 3). The ovipositor has a pair

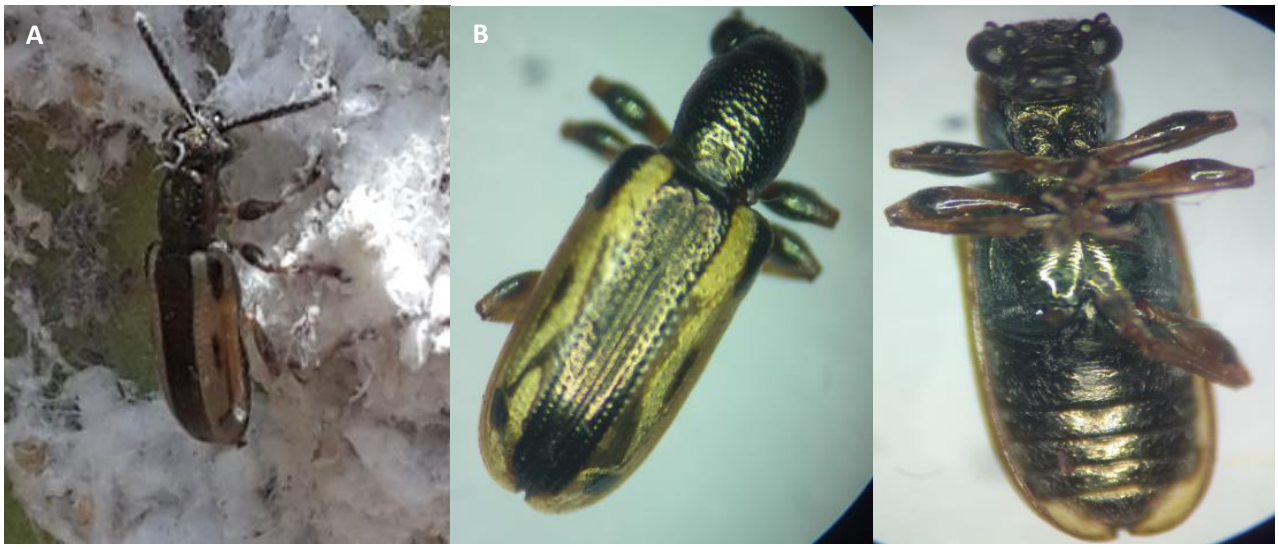

Fig. 1. Adult specimens of *Orsodacne altra*: A) *Orsodacne altra* associated to *D. opuntiae*; B) dorsal view; C) ventral view.

Fig. 2. Adult specimens of *Cyrtosus cyanipennis*: A) *Cyrtosus cyanipennis* associated to *D. opuntiae*; B) dorsal view; C) ventral view.

of baculi on its lateral side. The spiculum gastral is long, thin, and long. The proctiger is long, membranous but partially shorter than the ovipositor. The proctiger link to paraproct at its base. The paraproct is long and it has one long baculus whose anterior connects with the baculus of the valvifer. The coxite is sclerotized and long with a cylindrical apex. The valvifer is also long and distinguished easily from the coxite. The limit of the valvifer connects with the paraproct.

Description of *Cyrtosus cyanipennis* adults

Cyrtosus cyanipennis adults were elongated 5–9 mm long and 3–6 mm wide with an elongated, depressed body covered with black thin pubescence. The thorax was oblique with stripes yellow and black, hind coxa oblique, abdomen with 6 distinct ventrites. Antennae incorporate 11 antennomeres and were filiform in shape and legs with simple tibia and femora, all tarsi with 5 segments. *C. cyanipennis* male siphonal tube was abruptly straight with clear boundaries (4 bounds) forming a triangle at base, then straight upto apex. Apex cut shaped covered with limpid membrane (Fig. 4).

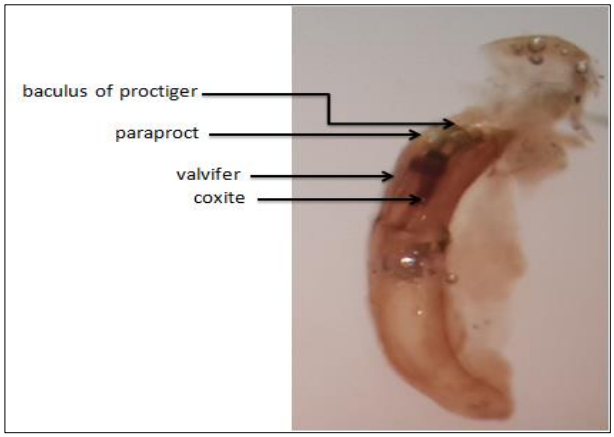

Fig. 3. Ovipositor of *Orsodacne altra* female.

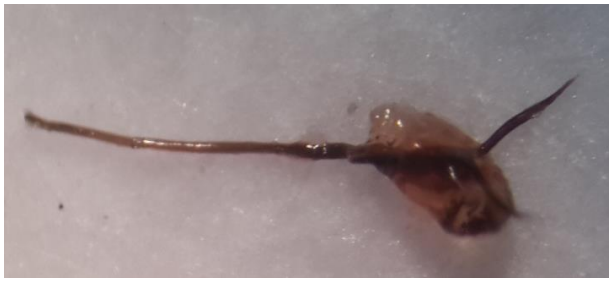
Fig. 4. *Cyrtosus cyanipennis* male genitalia.

Discussion

Orsodacne altra (Ahrens, 1810)

Evans (2014) reported that *Orsodacne altra* (Ahrens, 1810) is elongate (4–7 mm), narrow, somewhat convex, and variably black, dark red, or brownish yellow, sometimes with stripes or spots. Head is broad as pronotum. Pronotum with sides not keeled and narrower than base elytra. The same author indicated that Orsodacne adults strongly resemble a leaf beetle (Chrysomelidae), but their antennae are short, attached low on head between mandibles and eyes, and are not set on bumps or directed tilted back, and all tibiae are composed of pair of spurs and are tipped. Head with distinctly square labrum. Antennae filiform, with eleven antennomeres. Pronotum was round and not keeled or margined. Elytra covering and roofing abdomen rounded at apices. Abdomen with 5 distinct ventrites, each somewhat equal in length. The orsodacne species includes in Orsodacnidae family, superfamily of Chrysomelidae, which includes five other families Chrysomelidae, Megalopodidae, Oxypeltidae, Cerambycidae, Disteniidae, Vesperidae (Reid 2014). The determination of these species is difficult because is based mostly on poorly visible characters or fossil forms not very clear in vision (Reid 1995). Other authors rated orsodacnidae as subfamilies into family Chrysomelidae (Warchałowski 2003, Bieńkowski 2004; Lopatin & Nesterova 2005). The Chrysomelidae represents one of the superabundant and diverse families of living organisms (Santiago-Blay 2004). But in Europe and Middle East are relatively scarce: only 11 alien beetles of this group have been declared (Beenen & Roques 2010) and poorly studied (Beenen 2006). Chrysomelids species are mostly oligophagous, though some groups tend to be polyphagous (Şen & Gök 2009). Also, Mann & Crowson (1981) reported that the *Orsodacne* genus ovipositor was very comparable to most beetles in the Cerambycidae family. The key made by Kuschel & May (1990) using female genitalia characteristics shows that the Orsodacnidae and the Cerambycidae have a common characteristic description. Suzuki (1988) recorded that some reproductive characteristics in the Orsodacnidae family were absent in the Chrysomelidae family but they were present in some taxa in Cerambycidae. The present findings on the female genitalia in species *Orsodacne altra* are similar to earlier results showed by Suzuki (1988) and Li & Liang (2018). Some morphological characteristics of the larvae of *Orsodacne* were similar to other groups such as Eumolpinae, Criocerinae, Donaciinae, *Sagra*, and *Clytra* (Crowson 1967). Also on larva characteristics, Cox (1981) recorded that Orsodacninae was closer to the Donaciinae and Zeugophorinae, and Li & Liang (2018) indicated that the nine abdominal segments of *Orsodacne* are very similar to the same structure in some genera (*Colasposoma*, *Platycorynus,* and *Chrysochus*) placed in the Eumolpinae. Based on the female genitalia

characteristics Orsodacnidae may be an independent family but a sister family of Chrysomelidae and it was equal in status to Cerambycidae and Megalopodidae (Kuschel & May 1990, Reid 1995, Li & Liang 2018). Also, Li & Liang (2018) recorded that the *Orsodacne* external genitalia structure is rather primitive for Chrysomeloidea.

Cyrtosus cyanipennis (Erichson, 1840)

Cyrtosus cyanipennis adults examined had an elongated, depressed body. Yildirim & Bulak (2012) reported that the Malachiidae usually have an elongated, rather depressed body shape, often covered with setae and/or thin smooth, pubescence soft, generally colored and shiny (green or black, less or more spotted with red or yellow) integuments, antennae were filiform at times in males, with first segments dentate or knotted; thin and long legs with simple femora and tibia, all tarsi with 5 segments. Size is generally small, body length approximately ranging between 1.5 and 10 mm. *Cyrtosus* species include in the Malachiidae family. The first important study on the family Malachiidae was published by Erichson (1840). The following revisions were carried out by Peyron (1877) and Abeille de Perrin (1891). Malachiidae biology is rather poorly known. Adults are often predators but they may also be observed on vegetation, notably on flowers, where they may nourish on pollen, and larvae are found in leaf litter, under bark, and soil where they are predaceous and preyed on arthropod soft-bodied adults, larvae, and eggs (Yildirim & Bulak 2012). With this new report, we urge Moroccan entomologists and experts in plant protection to be on the conscience for this new potential polyphagous.

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Received: 26.10.2020
Accepted: 09.06.2021
Published online: 30.09.2021