

Systematics, Morphology and Biogeography

Description of immature stages of *Platycoelia valida* Burmeister, 1844 (Coleoptera: Melolonthidae: Rutelinae: Anoplognathini)



Jhon César Neita-Moreno^a, Miguel Ángel Morón^{b,*}

^a Instituto de Investigación de Recursos Biológicos Alexander von Humboldt, Claustro de San Agustín, Villa de Leyva, Colombia

^b Red de Biodiversidad y Sistemática, Instituto de Ecología, Xalapa, Mexico

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ABSTRACT

Description of immature stages of *Platycoelia valida* Burmeister, 1844 (Coleoptera: Melolonthidae: Rutelinae: Anoplognathini). Third instar larva and pupa of *P. valida* are described for the first time based on specimens collected in soils of yucca and coffee fields in Cundinamarca, Colombia. Illustrations of diagnostic structures and keys to the known third-stage larvae of Rutelinae tribes and *Platycoelia* species are included. Data on the biology and distribution of *P. valida* in Colombia are also commented.

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Introduction

The family Melolonthidae Leach, 1819 is a large group of beetles that includes over 19,700 described species worldwide (Morón, 1997; Morón et al., 2014; Cherman and Morón, 2014). Some adults of Melolonthidae are noticeable due to their relatively large size, bright colors, elaborate ornamentation, interesting life histories, and many interesting adaptations (Morón, 2004). The subfamily Rutelinae is composed of approximately 200 genera and 4100 species distributed worldwide (Machatschke, 1972). The English common name of the subfamily, the shiny leaf chafers, reflects the fact that many members of the subfamily are brightly colored, beautifully patterned, and often brilliantly metallic leaf-feeding beetles. Others in the subfamily, such as the species of *Anomala* Samouelle, are small, less spectacular beetles. Adult rutelines are phytophagous. Larvae feed on living roots, compost, and decaying plant parts such as logs, stumps, and roots (Morón, 1991). Although the larvae of many species are pest in some cultivated fields, their biology and taxonomy are poorly known.

Ritcher (1948, 1966) provided a larval key to the tribes of Rutelinae (excluding Geniatini and Anatistini). Pardo et al. (2006) described the larvae and pupa of *Leucothyreus femoratus* Burmeister for first time to Geniatini. Fuhrmann (2013) and Rodrigues et al. (2017) described larvae and pupae of two species of *Geniates*.

The preliminary state of knowledge of Rutelinae larvae makes accurate identification tenuous at best. The larva of only one species of Adoretini has been described (*Adoretus sinicus* Burmeister by Habeck (1963)), larva of *Anoplognathus suturalis* Boisduval (Anoplognathini) was described by McQuillan (1985), and only the larvae of Anatistini are completely unknown. Larvae of Rutelini are relatively well known (Jameson and Morón, 2001; Neita-Moreno and Morón, unpublished data), and a limited number of Anomalini genera and species have been described (Ritcher, 1966; Micó et al., 2003).

The genus *Platycoelia* Dejean, 1833 contains 63 species (Smith, 2003, 2009). Though the genus is well studied, the immature stages, biology, and natural history of *Platycoelia* species remain poorly known, and only two larvae have been described from the 63 known species (Pauca-Cabrera and Smith, 2002). According to our study on the larvae, the following combination of characters will separate *Platycoelia* species larvae from other Rutelinae larvae: head capsule yellowish, finely punctate; frontal and external setae absent. Labrum slightly asymmetrical, edge round. Ocelli present, and pigmented. Haptomerum prominent, basal and apical setae absent. Laeotorma with dilated apex. Galea with one uncus, lacinia with three sharp unci. Abdomen without palidia.

During the performance of the field work of the entitled project, "Taxonomy and distribution of white grubs (Coleoptera: Scarabaeidae "Pleurosticti") associated to five crops of agricultural importance in the department of Cundinamarca, Colombia", carried out by the first author (JCNM), it was possible to collect several larvae from different species of Rutelinae, Dynastinae and

* Corresponding author.

E-mail: miguel.moron@inecol.mx (M.Á. Morón).

Melolonthinae. These larvae were reared at the laboratory and later identified. In this paper, we describe for the first time the larvae and pupa of *Platycoelia valida* Burmeister, 1844, with a key to the known larvae representing most of the tribes of Rutelinae.

Material and methods

Terms and characters used in the larval and pupal descriptions are those of Ritcher (1966) and Morón (1987). Drawings of diagnostic structures were made using a Leica stereomicroscope 0.8–5.0× associated with a camera lucida, and measurements were obtained with an ocular micrometer (Leica microsystems, Germany). Voucher specimens are deposited at the Entomological Collection of *Instituto de Ecología*, A. C. Xalapa, Veracruz, México (IEXA) and in the private collection of first author in Bogotá, Colombia (JCNC).

Taxonomy

Descriptions

Platycoelia valida Burmeister, 1844 (Coleoptera, Scarabaeoidea, Melolonthidae, Rutelinae).

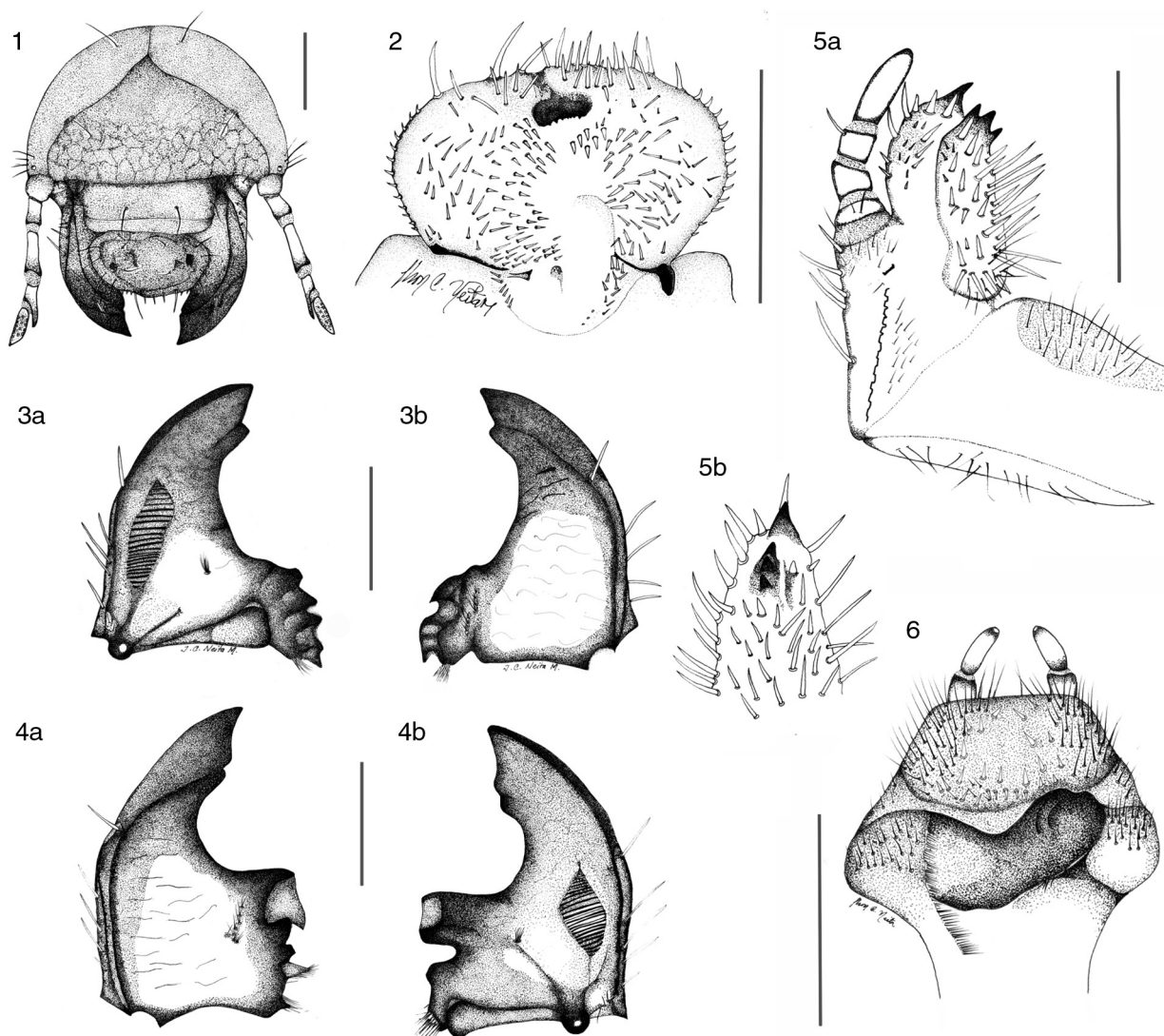
Third-instar larvae (Figs. 1–13). Description of *P. valida* is based on 23 third-instar larvae, and 12 female and two male pupae. These specimens were associated with 12 adults (seven females and five males) with the following collecting data: Colombia, Cundinamarca, San Francisco, Vereda Arrayán. Finca Tibulles. 4°58'39" N; 74°17'34" W, elevation 1670 m. Yucca field (*Manihot esculenta* Crantz, Euphorbiaceae), 16-III-2005. J. C. Neita.

Approximate dorsal body length 45–53 mm (Fig. 12). **Head.** Width of head capsule: 6.7–7.2 mm. Surface of epicranium, clypeus, and labrum reddish-brown; frons reddish-brown with anterior frontal angles black; mandibles reddish-brown with apex black. Surface of cranium (Fig. 1) finely punctate, with one dorsoepicranial setae, one posterior frontal seta at each side, one anterior frontal angle seta at each side, four paraocelar setae at each side; anterior frontal setae and exterior frontal setae absent. **Clypeus** (Fig. 1). Shape subtrapezoidal, surface rugose, punctures sparse, with two posterior setae, two central setae, four lateral setae at each side, apex with two setae slender and long. Ocelli present, pigmented. **Epipharynx** (Fig. 2). Form suboval, corypha with four long, slender setae. Epizygon sclerotized, prominent. Haptomerum with 6–8 apical, stout heli, basal heli absent. Right chaetoparia with 28 slender, short setae, 53 slender, long setae; left chaetoparia with 21 stout, short setae, 44 slender, long setae; acroparia with 16 slender, long setae; acanthoparia with 13–15 short, curved, spinose setae; pedium short, ovate. Dextiotorma long, pterotorma weakly developed and round. Laetotorma long, shorter than dextiotorma, with apex dilatated toward pedium. Laeophoba well developed between haptolachus and inner side of laetotorma, with 15 slender, long filaments; haptolachus with three microsensilla. Dextiophoba absent. Sclerotized plate of right nesium long, elongate, apex truncate; sense cone on left nesium represented by longitudinal, well sclerotized plate, apex with four sensilla. Crepis poorly developed. **Mandibles.** Right mandible (Figs. 3a and b). Scissorial area with three teeth (S_1 , S_2 and S_3) the S_3 separated from S_2 by scissorial notch. Molar area with two large lobes (M_{1-2}), distal lobe (M_1) developed; scrobis with four long, slender setae; four short, slender basolateral setae; brustia with 19 slender, and moderated long setae; acia elongate with some setae on the base and apex. Ventral surface (Fig. 3a) with elongate-oval stridulatory area formed by 25 narrowly separated ridges; four dorsomolar setae; ventral process well developed, rounded, with many asperities. Dorsal surface (Fig. 3b). With line of 13

dorsomolar setae. Left mandible (Figs. 4a,b). Scissorial area with three teeth (S_1 , S_2 and S_3) the S_3 separated from S_2 by scissorial notch. Molar area with two wide lobes (M_{1-2}), distal lobe (M_1) developed, near to molar area; scrobis with four long, slender setae; four short, slender basolateral setae; brustia with 19 slender, and moderated long setae; acia elongate with some setae on the base and apex. Ventral surface with elongate-oval stridulatory area formed by 25 narrowly separated ridges; 4 dorsomolar setae; ventral process well developed, rounded, with many asperities. Dorsal surface with line of 13 dorsomolar setae. Maxilla (Figs. 5a and b). Galea with one uncus; ventral surface with 6–9 short, stout setae. Lacinia with three sharp unci, nine moderate to long setae. Stipes with 15 short stridulatory teeth, apical edge acute, anterior process truncate (Fig. 7). Maxillary palpus with four palpomeres, last palpomer twice as long as 2nd. Hypopharynx (Fig. 6). Glossa with slender setae, 34 long, and 40 short setae, 20 stout, short setae spine-like on center. Hypopharyngeal sclerome asymmetrical, concave medially, with an acute dorsal process. Left lateral lobe with slender setae, 11 long setae, eight short setae; right lateral lobe with 21 slender, moderately long setae. Left margin with row of 14 stout, moderately long setae, directed toward center of sclerome, and with three setae near sclerome base. **Antenna.** Four antennomeres present, first shorter than second; dorsal surface of last antennomer with 12–14 sensory spots (Fig. 8a), ventral surface with 11–13 sensory spots (Fig. 8b).

Thorax. Pronotum wide, with irregularly and weakly sclerotized lateral plates, each with three slender, long setae. Prothoracic spiracle (Fig. 9a–c) 0.55 mm long, 0.42 mm wide; respiratory plate dark brown, regularly shaped as a closed “C”, spiracular bulla rounded, slightly prominent; distance between respiratory lobes less than diameter of bulla; respiratory plate with 32–39 holes across middle diameter, holes with irregular edges (Fig. 9c). Prothoracic dorsum with transverse row of eight long, slender setae. Mesoprescutum with two long, slender setae; mesoscutellum glabrous. Metaprescutum with 22 long, slender setae and 20 short spinose setae; metaescutellum glabrous. **Legs** (Fig. 11A–B). Tarsal claws with enlarged apical process, one basi-external seta, and one internal, preapical seta. Tarsal claws of pro- and metathoracic legs longer than those of mesothoracic legs. Coxae, trochanteri, and tibiotarsi with many fine, stout setae.

Abdomen. Spiracles I (0.57 mm long and 0.36 mm wide), shorter than spiracles II–VII (0.65 mm long and 0.52 mm wide). Respiratory plate dark brown, regularly shaped as a closed “C”, spiracular bulla rounded, slightly prominent; distance between respiratory lobes less than diameter of bulla. Prescutum of segment I with two long, slender setae and two short, spinose setae; subscutum with 1 one long, slender setae and with no short setae; scutum with about 24 short, spinose setae, 12 long, slender setae; scutellum with about 19 short, spinose setae, six long, slender setae. Prescutum of abdominal segment II with two long, slender setae, 16 short, spinose; subscutum with one short, spinose seta; scutum with 15 long, slender setae and 42 short, spinose setae; scutellum with six long, slender setae and 31 short, spinose setae; spiracular area with three long, slender setae. Prescutum of abdominal segment III with two long, slender setae, 28 short spinose setae; subscutum with one short, spinose seta; scutum with 13 long, slender setae, 60 short, spinose setae; scutellum with eight long, slender setae, 48 short, spinose setae, three longer; spiracular area with slender setae. Prescutum of abdominal segment IV with two long, slender setae, 30 short spinose setae; subscutum with one short, spinose setae; scutum with 13 long, slender setae, 60 short spinose setae; scutellum with eight long, slender setae, 48 short spinose setae; spiracular area with four long, slender setae. Prescutum of abdominal segment V with two long, slender setae, 33 short spinose setae; subscutum with one short, spinose setae; scutum with 15 long, slender setae 58 short spinose setae; scutellum with eight

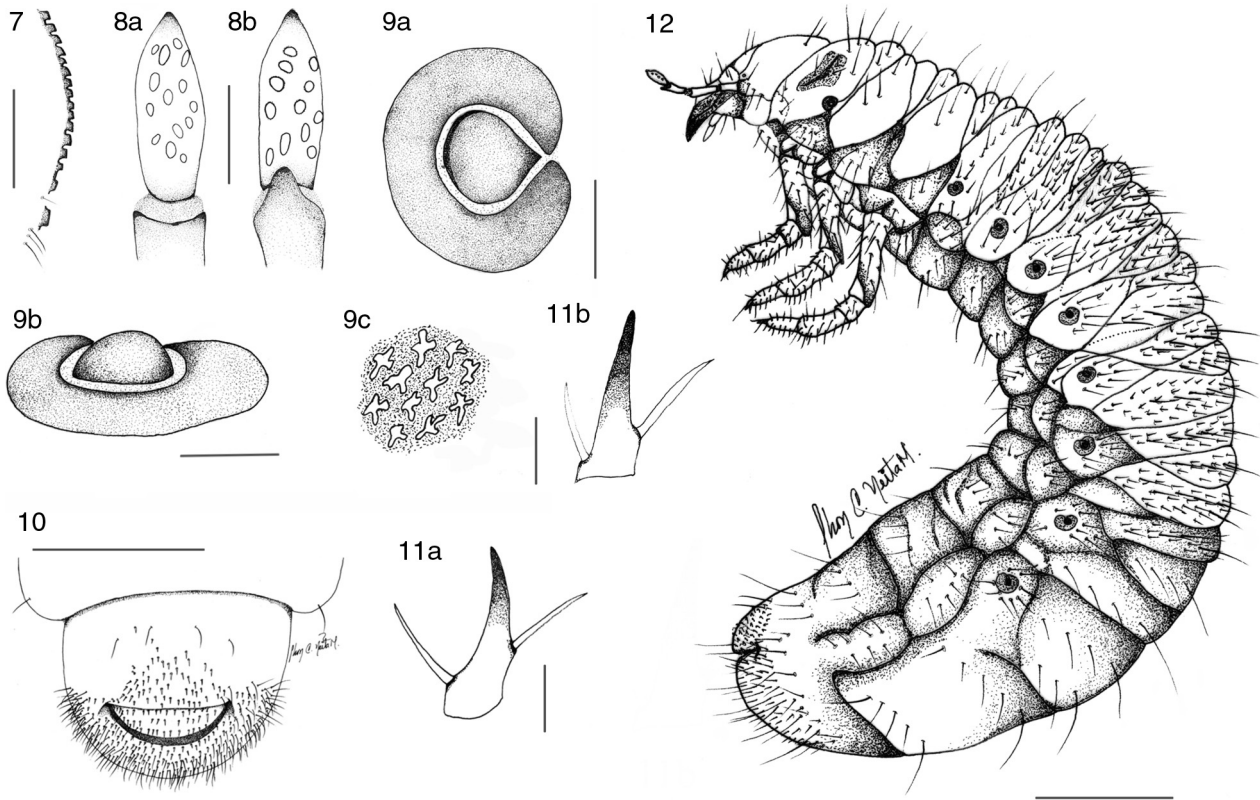


Figs. 1–6. *Platycyelia valida*, third instar larva. 1, cranium, frontal view. 2, epipharynx. Right mandible: 3a, ventral view, 3b, dorsal view. Left mandible: 4a, dorsal view, 4b, ventral view. Maxilla: 5a, dorsal view, 5b, mesial view, showing unci. 6, hypopharynx showing hypopharyngeal sclerome. Scale lines = 2 mm.

long, slender setae, 46 short spinose setae; spiracular area with four long, slender setae. Prescutum of abdominal segment VI with two long, slender setae, 38 short spinose setae; subscutum with one short, spinose setae; scutum with 16 long, slender setae, 45 short spinose setae; scutellum with eight long, slender setae, 19 short spinose setae; spiracular area with five long, slender setae. Spiracular area of abdominal segment VII with two rows of nine slender, long setae; five long, slender setae. Spiracular area of abdominal segment VIII with one transversal row of six slender, six long, slender setae. Abdominal segment IX with one anterior transversal row of two slender, long setae and posterior transversal row with six long, slender setae. Abdominal segment X with mixture of approximately 47 moderate to long, slender setae and 131 short, spinose setae. Pleural lobes with 22 long, slender setae, short spinose setae absent. Raster (Fig. 10). Surface without palidia; campus with four long, slender setae; teges with 79 short setae extended toward superior anal lobe, barbula with 16 long, slender setae. Anal slit transverse.

Pupae. Female (Fig. 13a–c). Total length 32 mm. Widest width 15 mm. Male (Fig. 13d). Total length 25 mm. Widest width 13 mm. Body shape elongate, oval, stout. Color dark reddish orange. Entire body with fine, velvety-gold vestiture. **Head.** Surface glabrous, bent sharply beneath thorax, mouthparts directed ventrally; antenna,

labrum, mandibles, maxillae and palps discernible; antennal thecae expanded, stout with apex rounded. Compound eyes sunken, scarcely visible. Frons without tubercles. **Thorax.** Pronotal surface glabrous, form nearly transverse with wide, anteromedial, rounded apex, massive tubercle slightly defined. Meso- and metanotum well-differentiated. Elytral and posterior wing thecae closely appressed, curved ventrally around body; elytral thecae extending until third abdominal segment middle; posterior wing thecae extending until fourth abdominal segment IV middle. Protibia with 3 distinct teeth on external edge. Meso- and metatibiae with inner and external spines well-developed at apex. Mesosternal process well developed. Abdomen. Segments III–X (ventral view) well-defined, segment VII slightly longer than preceding ones, and VIII 0.25 times longer than segment VII; segments VIII and IX fused. Segment X with genital ampulla well developed (male) or slightly developed (female) (Fig. 13d–f). Segments I–X (dorsal view) with 5 well-defined dieneiform organs; organs strongly sclerotized between segments I–II, II–III, III–IV, IV–V, and V–VI. Pleural lobes rounded. Spiracle I elongate, with fine peritreme and covered by wing thecae; spiracles II–IV ovate, prominent, with strongly sclerotized peritreme; spiracles V–VIII closed. Abdominal apex rounded, with mixture of slender and short setae.



Figs. 7–12. *Platycœlia valida*, third instar larva. 7, maxillary stridulatory teeth. Last antennomere: 8a, ventral view, 8b, dorsal view, showing sensory spots. Prothoracic spiracle: 9a, dorsal view, 9b, lateral view, 9c, respiratory plate holes. 10, raster. Lateral view of claw: 11a, mesotarsus, 11b, metatarsus. 12, lateral view of complete body. Scale lines = 0.5 mm, except in Figs. 10, 12 = 5 mm.

Biology. Adults are nocturnal, usually attracted to electric lights. They use to fly from 6:00 PM to 04: 00 AM. Adult emergence occurs during the second rainy period of the year (October–November). Larvae are found around 15–30 cm underground. After the first annual rainy season (March–May), becomes a dry period (June–September), during this last period the larvae build their pupal chambers at 30 cm deep. The pupa is surrounded

by larval exuvium as in other Rutelinae (Morón, 1993). Larvae were found parasitized by an unidentified species of Diptera; prepupae in their pupal cells are also accompanied by the immature stages of these fly. The life cycle of this species is completed in one year. The larva and pupa were found in soils with crops of coffee, *Coffea arabica* L. (Rubiaceae) and yucca, *Manihot esculenta* Crantz. (Euphorbiaceae).

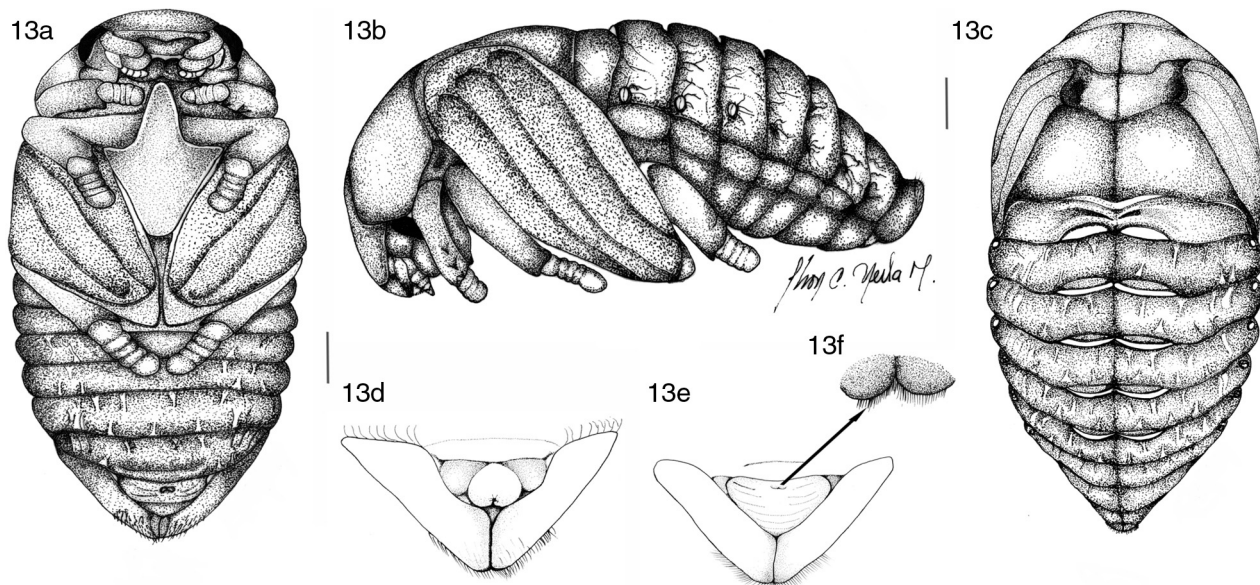


Fig. 13. Pupa of *Platycœlia valida*. 13a, ventral view, 13b, lateral view, 13c, dorsal view. Ventral view of last abdominal segment showing genital ampulla: 13d, male, 13e, female, 13f, detail of dorsal view of genital plate of female. Scale lines = 2 mm.

Distribution. *P. valida* is restricted to Colombia, on the eastern slope of Cordillera Oriental from the inter-Andean valleys at elevations from 1500 to 1900 m in Cundinamarca.

Conflicts of interest

The authors declare no conflicts of interest.

Key to known third-instar larvae of Rutelinae tribes of the world

1. Epipharynx with prominent haptomerum, without a row of basal principal or secondary heli. 3
- 1' Epipharynx with or without prominent haptomerum, but with a row of basal principal or secondary heli. 2
2. Last segment of antenna with a single dorsal sensory spot; ventral area of right mandible without dorsomolar setae. Anomalini Streubel.
- 2' Last segment of antenna with two or more dorsal sensory spots; ventral area of right mandible with dorsomolar setae. 4
- Rutelini MacLeay (see Jameson and Morón, 2001)
3. Palidia present. ... Geniatiini Burmeister (*Leucothyreus* MacLeay, *Geniates* Kirby).
- 3' Palidia absent. 4
4. Plegmatium narrow. Last antennal segment with single dorsal sensory spot. Adoretini Burmeister (Ethiopian, Oriental and Australian Regions).
- 4' Plegmatium absent. Some species with 2 or more dorsal sensory spots. (*Anoplognatus* MacLeay, *Platycoelia* Dejean)

The knowledge of the immature stages has been historically important for the systematic of Scarabaeoidea. The main characters of the larvae of scarabaeiform type are considered as synapomorphic characters supporting the monophyly of Scarabaeoidea within the order Coleoptera. Scarabaeoidea is one of the most diverse superfamilies within Coleoptera, yet, the immature stages of only 1.0% of its species have been so far described. The immature stages described for Melolonthidae have been increasing (Ritcher, 1966; Neita and Morón, 2008; Neita and Orozco, 2009; Castro-Ramírez and Ramírez-Salinas, 2010; Neita and Ratcliffe, 2011; Neita et al., 2012; Fuhrmann, 2013; Neita et al., 2014; Salazar-Niño and Serrão, 2015; Rodrigues et al., 2017). By other hand, Grebennikov and Scholtz (2004) carry out a phylogenetic analysis testing the importance of the larval characters in supporting the proposals made so far on the basis of adults. More recently, some studies have included characters from the morphology of the larvae in their phylogenies improving the resolution of the relationships within their group of study Ahrens (2006), Micó et al. (2008) and Šípek et al. (2011).

According to Neita (unpublished data), the larvae of *P. valida* exhibits derived characters as: haptomerum with 6–8 apical, stout heli, basal heli absent; dexiophoba absent; mandibles ventral surface with elongate-oval stridulatory area; maxillae with galea and lacinia fused, stipe with short stridulatory teeth with apical edge acute, anterior process truncate; raster without palidia; campus with four long, slender setae; teges with 79 short setae that project toward superior anal lobe, barbula with 16 long, slender setae; and anal slit transverse. All these characters support the inclusion of *P. valida* as part of the Rutelinae lineage.

Key to the known third instar larvae of Platycoelia Dejean

1. Last segment of antenna with 12–13 dorsal sensory spots. 2
- Platycoelia valida* Burmeister
- 1' Last segment of antenna with a single dorsal sensory spot. 2
2. Epipharynx with laeotorma shorter than dexiortorma; mandible with three scissorial teeth; abdominal spiracles round. 2
- Platycoelia gaujoni* Ohaus
- 2' Epipharynx with laeotorma longer than dexiortorma; mandible with two scissorial teeth; abdominal spiracles elongate. 2
- Platycoelia lutescens* Blanchard

The economic importance of *Platycoelia valida* in crops

The larvae of many species of Melolonthidae are root feeders, with adults feeding on leaves and fruits of some crops of agricultural importance in Colombia and other countries. Around the world, about 45 species of Melolonthinae and Rutelinae have been reported feeding on coffee plant as adults. In Colombia, *P. valida* adults are reported feeding on flowers and green cherries, causing the defoliation under shade (Cárdenas and Posada, 2001). Yet, the damages produced to the coffee and yucca crops are minimal, so this species is not considered as economically important.

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