

RESEARCH ARTICLE

**GENITALIA STRUCTURE OF THE INSECT
PYCNODACTYLOPSIS TOMENTOSA TOMENTOSA (FÅHRAEUS, 1842)
(COLEOPTERA: CURCULIONIDAE: LIXINAE) IN EGYPT**

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ABSTRACT

Article History:

Received: 6 November 2024

Accepted: 23 November 2024

Published Online:

26 November 2024

Keywords:

Cleonini; Genitalia;

Morphology; *Pycnodactyloopsis*;
SEM

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The male and female genitalia usually exhibit distinguishing features that aid in differentiating between genera and species; hence, the study of genitalia is expected to be crucial to the taxonomy of insects. Morphological description of genitalia of many genera and species of the tribe Cleonini (Subfamily: Lixinae) has remained a neglected area. In the current study, we presented the descriptions of the male and the female genital external structures of the genus *Pycnodactyloopsis* Voss, 1963, where the genitalia of both sexes of *Pycnodactyloopsis tomentosa* (Fåhraeus, 1842) from Egypt were examined and photographed through both light and scanning electron microscopy (SEM), as well as full details were described and illustrated for the first time to the best of our knowledge. Diagnostic characters of each of the genus and species were also explained.

INTRODUCTION

There are approximately 400000 species of beetles that have been described^[1,2], of which 62000 are Curculionoidea (weevils), which represents 15.5%. The Curculionidae Latreille, 1802 is one of the taxonomic groupings with the greatest potential for understanding the evolution of diversity, and it is also one of the most difficult to classify^[3,4]. Nearly 600 species and subspecies constitute the tribe Cleonini within the subfamily Lixinae under the family Curculionidae, which are primarily found in the Palaearctic and Afrotropical Zones. Among the 90 known genera of the tribe Cleonini, 19 genera are recorded in the Egyptian fauna^[5]. In this study, we deal with the genus *Pycnodactyloopsis* Voss, 1963. The genus *Pycnodactyloopsis* contains eight species worldwide. According to Ahmed *et al.*^[5] and the online catalogue by Meregalli (2017)^[6], six of which are

restricted to the Indo-Malayan and Afrotropical fauna, while the other two species are Palaearctic, of which *P. tomentosa tomentosa* (Fåhraeus, 1842) was recorded from Egypt in the monograph of Alfieri (1976)^[7]. This species is widely distributed over Northern Africa, India, and the Canary Islands^[5,8].

The insect's genitalia, especially of males, are renowned for their diversity in structure and function. There is a lot of phylogenetic information in this anatomical region, and this variation has been very helpful in classifying insects at different taxonomic levels^[9]. Thus far, relatively little research has been done on the Egyptian Curculionoidea fauna. Accordingly, in this work we illustrated the structure of the genitalia of both sexes of *Pycnodactyloopsis tomentosa tomentosa* for the first time to the best of our knowledge using both light and scanning electron microscopy.

MATERIAL AND METHODS

A binocular microscope, model: LABOMED CZM4 (Los Angeles, CA, USA), was used to examine the specimens. The last abdominal segments were removed and immersed in a saturated KOH solution for three to five hours. They were then put in a petri dish with drops of glycerin and alcohol, so that they could be viewed *via* a stereomicroscope. The specimens were then kept in absolute alcohol for a more thorough examination. To keep them from drying out, the genitalia were kept in glycerin-filled plastic microvials. The genitalia were photographed with a 12 Megapixel 1080p camera with a 50× to 1200× magnification power and 10 programmable LED lights (two side lights and eight built-in lights).

For scanning electron microscopy (SEM), specimens were dissected and genitalia were cleaned and dried then placed on SEM specimen holders, or stubs, using double-sided adhesive carbon tape. After that, they were coated in gold using sputtercoater and finally examined and photographed using electron microscope (Jeol Jsm, version 5200, Peabody, MA, USA). Observations were made at 1000× and 3000×. The SEM

performed in Applied Center for Nematodes, Faculty of Agriculture, Cairo University, Cairo, Egypt. The genital nomenclature is based on the works of Meregalli (2009)^[10], Gültekin (2013)^[11] and Arzanov and Grebennikov (2017)^[12].

RESULTS

Genus *Pycnodactylopsis* Voss, 1963

Louwia Alonso-Zarazaga and Lyal, 1999^[13]

Pajnisoodes Alonso-Zarazaga and Lyal, 2002^[14]

Type of Species: *Pycnodactylus schaeuffelei* Voss, 1963

Diagnosis

Rostrum dorsally without carina, but with two basal furrows (Figure 1A), head without frontal pit; first and second segments of antennal flagellum nearly equal in length (Figure1B).

Pycnodactylopsis tomentosa tomentosa (Fåhræus, 1842)

Cleonus tomentosa Fåhræus, 1842

Cleonus cretosa Fairmaire, 1868

Pycnodactylus fuscoirrtortus Chevrolat, 1873

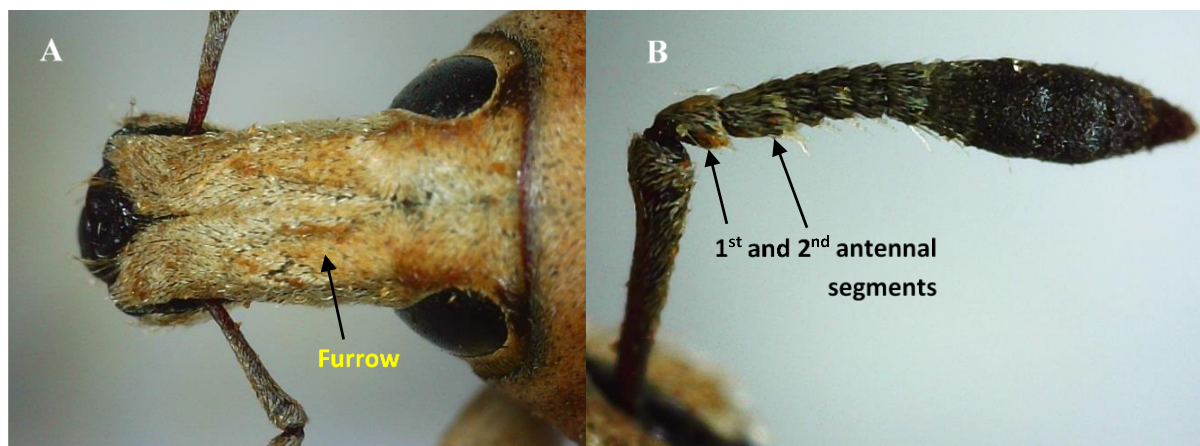


Figure 1: *Pycnodactylopsis tomentosa tomentosa* (Fåhræus, 1842). (A) Dorsal view of head, (B) antenna.

Genitalia of *Pycnodactylopsis tomentosa tomentosa* (Fåhræus, 1842)

Male genitalia: at lateral view, the aedeagal tube is highly bent (Figure 2A), strongly sclerotized, and has a porous surface (Figure 3C). The aedeagal pedon is extremely

sclerotized, pointed apically, broadened and cornered in the center, and constricted at the base. At dorsal view, the aedeagal tube is wider basally, somewhat narrower apically (Figure 3A). Tegmen, a ring-like structure, is located at the base of the

aedeagal tube (Figures 2C and 3D), the manubrium attached with tegmen ventrally, it is slightly long and strongly sclerotized structure, with curved and flattened apex, and the ostium from which the endophallus

emerges appears to be near the apex of the aedeagus (Figure 3A,B). Narrow T-shaped structure with a basal curvature makes up the ninth sternite (Figure 2D).



Figure 2: Male genitalia of *Pycnodactylopsis tomentosa tomentosa*. (A) Aedeagus lateral view, (B) aedeagus dorsal view, (C) focus on posterior part of aedeagus showing tegmen, (D) 9th sternite, (E) tergite VIII. Aa: Aedeagal apodeme, Ap: aedeagal pedon, Ma: manubrium, Te: tegmen.

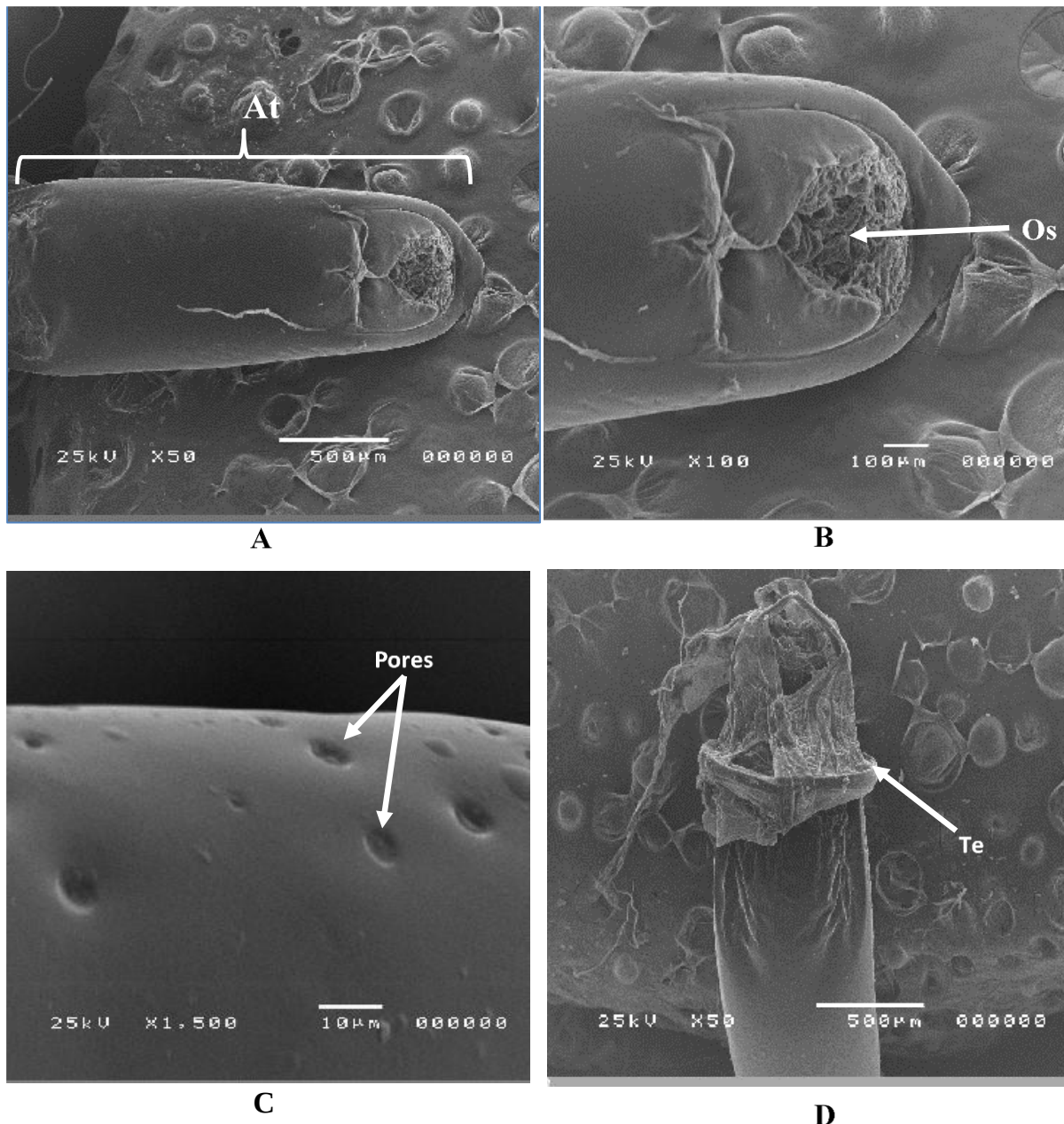


Figure 3: Scanning electron micrograph of male genitalia of *Pycnodactylopsis tomentosa tomentosa*. (A) Aedeagal tube, dorsal view, (B) apical margin of aedeagus, (C) pores on the surface of aedeagal tube, (D) basal part of aedeagal tube showing tegmen. At: Aedeagal tube, Os: ostium, Te: tegmen.

Female genitalia: sternite VIII is elongated, U-shaped, moderately sclerotized, and broader apically and narrower basally (Figures 4B and 5A), with two straight arms (lamellae) united with abroad base and ended with two small blades separated by a short distance and with a vertical row of short hairs (Figures 4C and 5B), transparent membrane between arms of lamellae and blades is found. Gonocoxite is a broad, triangular structure that narrows at the apex

to produce a cylindrical base bearing styli and an apical tuft of setae (Figures 4D and 5C). The styli are mostly three and strongly sclerotized (Figure 5D). Spermatheca is C-like structure, strongly sclerotized, with strongly curved obtuse cornu, moderately long ramus that is nearly half as wide as collum (Figure 4E). Tergite VIII has a semicircular shape and is roughly twice as wide as long (Figure 4A).

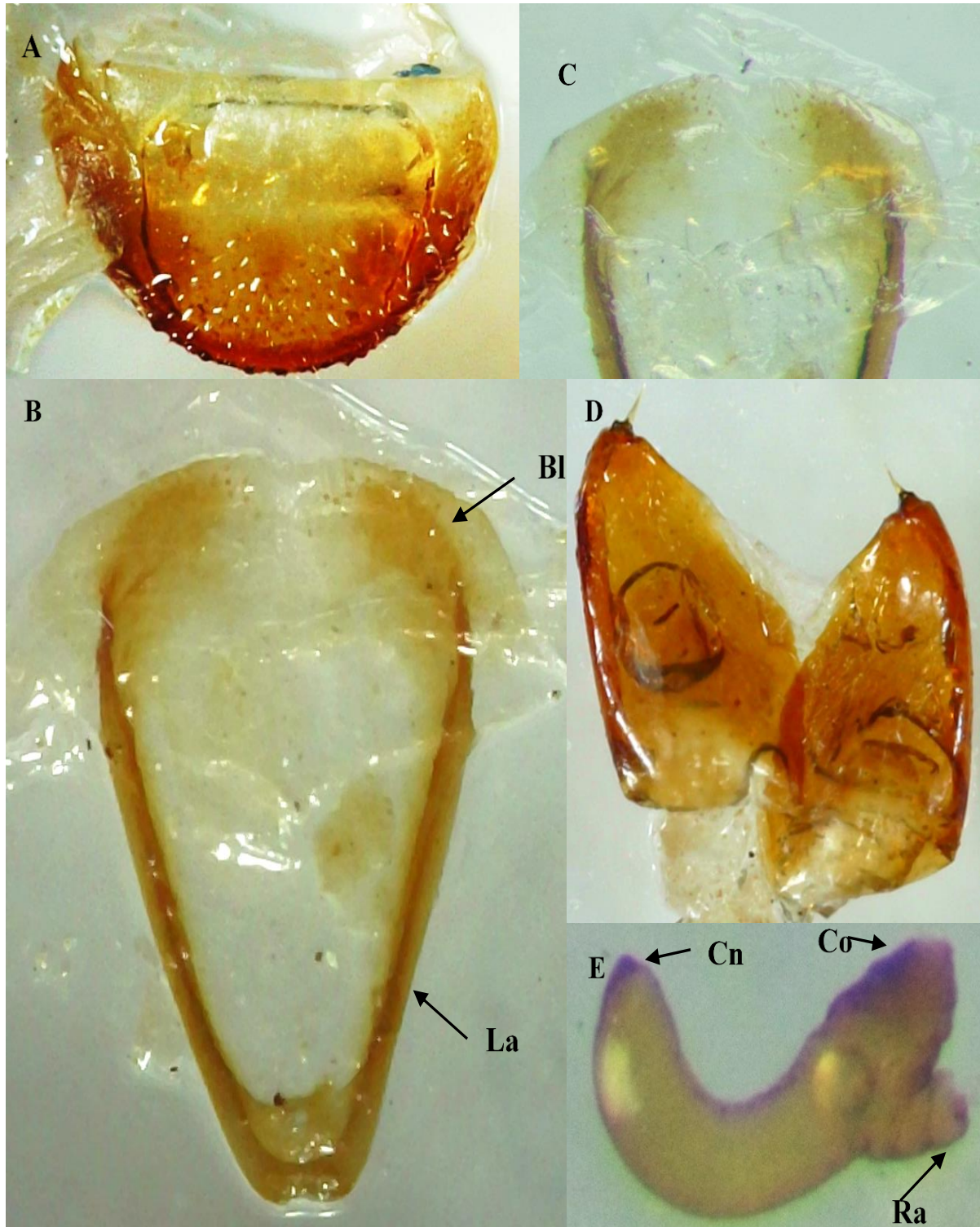


Figure 4:Female genitalia of *Pycnodactylopsis tomentosa tomentosa*. (A) Tergite VIII, (B) sternite VIII, (C) apical part of sternite VIII, (D) gonocoxite, (E) spermatheca. Bl: Blade, Cn: cornu, Co: collum, La: lamella, Ra: ramus.

Specimens examined

El Shazly (29 samples; date of collection: 28/6/1994), Gabal Elba (one sample; date of collection: 10/2/1994) and 50 km Abu El Hassan El Shazly Road (one sample;

collection: 28/6/1994), Red Sea Governorate, Egypt Collection of Ain Shams University, Faculty of Science, Entomology Department.

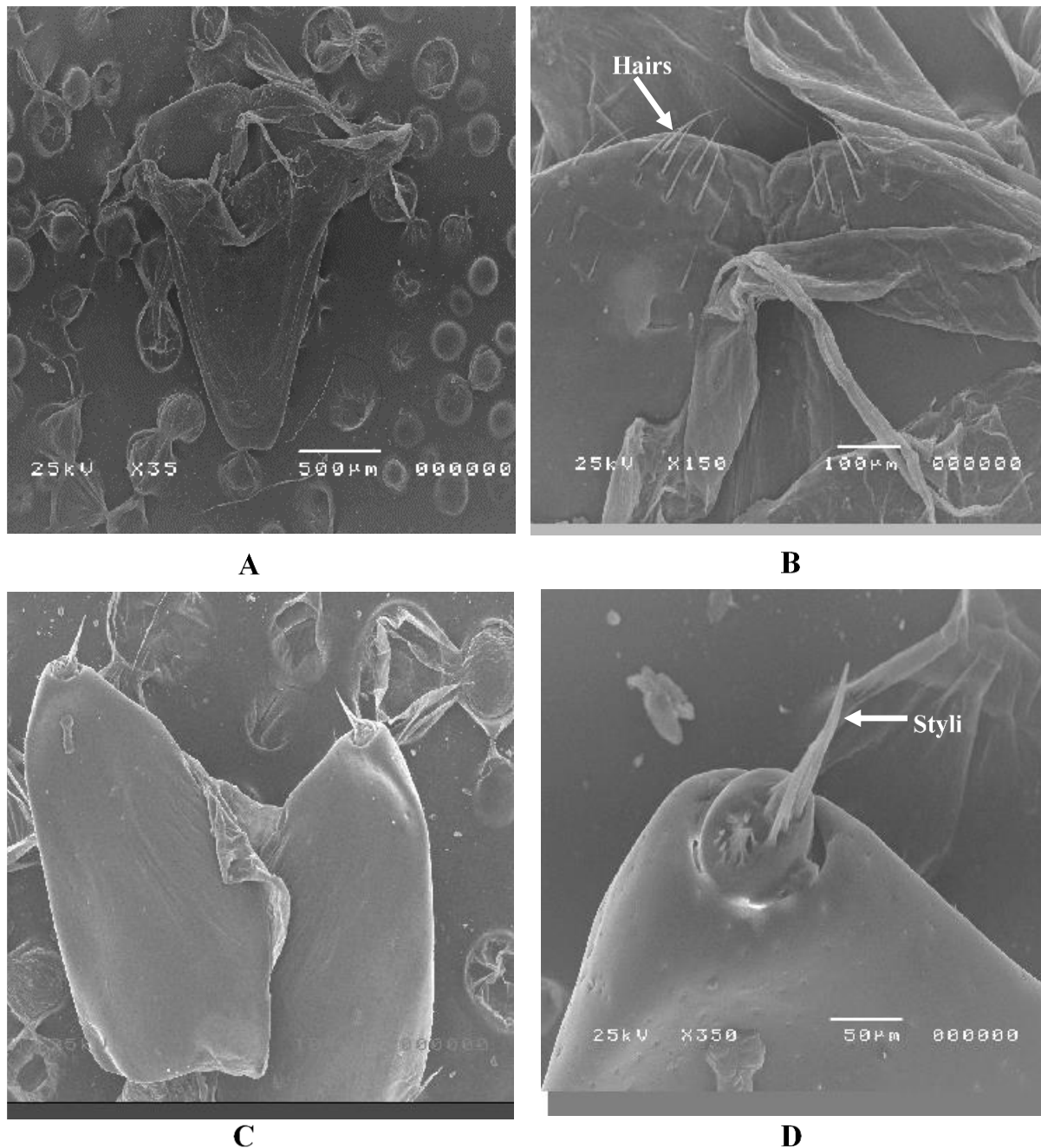


Figure 5: Scanning electron micrograph of female genitalia of *Pycnodactylopsis tomentosa tomentosa*. (A) Sternite VIII, (B) hairs on apical part of sternite VIII, (C) gonocoxite, (D) styli on apical part of gonocoxite.

DISCUSSION

The male genitalia of many insects are often used for taxonomic reasons due to their sufficiently complex structure and various species- or taxon-specific features. Because they are used to contact females during sexual encounters, male genitalia can evolve more quickly than other morphological components. Theories explaining this pattern point to sexual selection by female choice

and sexually antagonistic coevolution as a result of male-female conflict during fertilization^[15]. Therefore, it can be said that "the study of genitalia undoubtedly serves an important role in the taxonomy of insects" because male genitalia typically exhibit different characteristics that aid in the separation of genera and species^[16]. The male genitalia have been examined by several authors in the family Curculionidae

who recognized the genital structures and compared shapes or sizes of these structures among species^[17].

On the other hand, some authors, such as Tanner (1961)^[18] and Aslam (1961)^[19], have accepted that the female genitalia are the source of taxonomically significant features in the Coleoptera, and they have used the size and shape of these structures to diagnose different species. Furthermore, spermatheca, genital spicule, ovipositor styli, and eighth abdominal sternite may be useful taxonomic features to distinguish between various genera and species, according to research done by Stone *et al.* (1971)^[20], Pajni *et al.* (1977)^[21], Sert (1997)^[22], and Erbey *et al.* (2013)^[23] on the female genitalia of numerous taxa in the family Curculionidae.

The genitalia of *Pycnodactylopsis tomentosa tomentosa* were not covered in any of the earlier studies on the family. The chitinization and sculpturing of structures (such as spines, tubercles, pits, or folded structures) are clearly visible by SEM; whereas, in a light microscope, similar features are not sufficiently visible as previously reported^[23]. The morphology of genitalia in both sexes of *Pycnodactylopsis tomentosa tomentosa* was shown in the current study, for the first time to the best of our knowledge, by using a combined light and scanning electron approach. The diagnostic structure, which had been mentioned in earlier research on the family's species, was described and illustrated to help with the species' diagnosis.

ACKNOWLEDGEMENT

Authors express our gratitude to the curators at Cairo University's Faculty of Agriculture's Applied Center for Nematodes for handling the SEM images.

ETHICAL APPROVAL

This research was approved by the Animal Ethics Committee of Zagazig University (ZU-IACUC/1/F/247/204).

FUNDING SOURCES DISCLOSURE

This study did not receive any fund.

CONFLICT OF INTEREST

There are no conflicts of interest to declare.

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How to cite this article:

Abdel-Halim, F. A. and Abu El-Hassan, G. M. M. (2025). Genitalia structure of the insect *Pycnodactylopsis tomentosa tomentosa* (Fåhraeus, 1842) (Coleoptera: Curculionidae: Lixinae) in Egypt. *Egyptian Journal of Zoology*, 84: 34-42 (DOI: 10.21608/ejz.2024.334249.1125).

تركيب الأعضاء التناسلية لحشرة *Pycnodactylopsis tomentosa tomentosa* (Fåhraeus, 1842) (Coleoptera: Curculionidae: Lixinae) في مصر

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عادة ما تُظهر الأعضاء التناسلية الذكرية والأنثوية سمات مميزة تساعد في التمييز بين الأجناس والأنواع؛ ومن ثم، من المتوقع أن تكون دراسة الأعضاء التناسلية أمراً حاسماً في تصنيف الحشرات. ظل الوصف المورفولوجي للأعضاء التناسلية للعديد من أجناس وأنواع قبيلة "Cleonini" (فصيلة: Lixinae) منطقة مهملة. لذلك قدمنا في الدراسة الحالية الأوصاف الخارجية للأعضاء التناسلية الذكرية والأنثوية لجنس *Pycnodactylopsis* Voss, 1963، حيث تم فحص وتصوير الأعضاء التناسلية لكلا الشقين من نوع *Pycnodactylopsis tomentosa tomentosa* (Fåhraeus, 1842) من مصر وذلك باستخدام الميكروسكوب الضوئي والميكروسكوب الإلكتروني الماسح، بالإضافة إلى وصف وتوضيح التفاصيل كاملة لأول مرة لحد علمنا. كما تم أيضاً توضيح الخصائص التشخيصية لكل من الجنس والنوع.