



The Male Genitalia in *Lixus nordmanni* Hochhuth, 1847 (Coleoptera: Curculionidae: Lixinae); Studing by Light and Scanning Electron Microscope

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ABSTRACT

The male genitalia of *Lixus nordmanni* Hochhuth, 1847 (Curculionidae: Coleoptera) were examined by optical and scanning electron microscope (SEM). A detailed description is provided. In *Lixus nordmanni*, the male genitalia is annulate type, and it consists of aedeagus and 9th sternite (spiculum gastrale). The aedeagus has two main parts; aedeagal tube and tegmen. The aedeagal tube is curved basally and seems long and cylindrical. It is strongly sclerotised. The 9th sternite is very thin and long, and its apex connected the wide plate which is convex.

Key Words : Coleoptera, Curculionidae, *Lixus nordmanni*, aedeagus, tegmen, 9th sternite, SEM

1. INTRODUCTION

In insects, the male genitalia and associated internal sclerotised plates have been recognised as a source of taxonomically important characters in Coleoptera for some 200 years [1]. Sharp and Muir [2] pioneered the fundamental work on beetle genitalia, and first recognised the similarities of the curculionid and chrysomeloid aedeagus linking these groups in the series phytophagoidea. They were followed by Crowson [3, 4], who characterised and considered the most important, several general types of coleopterans, including the “trilobate, sheath, cucujoid, heteromeran and chrysomeline” types. The nomenclature, rather than principles of division, was modified by d’Hotman and Scholtz [5], who recognised four basic types: trilobate, articulate, vaginate and annulate [1]. Generally, the male genitalia occurs annulate type in Curculionidae, and consists of the aedeagus and the spiculum gastrale (called “9th sternite (S9)” by Wanat

[1]) [6]. The weevil’s aedeagus is a sclerotised tubular organ containing a membranous eversible endophallus (internal sac) and is connected to the tegmen by the post tegminal membrane [1].

The membran is attached to the base of aedeagal tube, and at the same place paired lateral projections of the tube (actually sclerotised evaginations of the membrane) are developed to from aedeagal apodemes [1]. The weevil aedeagal tube may be divided into two movable parts: the dorsal tectum and ventral pedon, consisting of a ventral pedon with upfolded margins and the dorsal part of the tube membranous, or the tube is evenly sclerotised both ventrally and dorsally along most of its length. The pedon gives shape to the aedeagus and its apex and sides are always heavily sclerotised. The pedon’s venter may be either entirely sclerotised, bearing a notch filled by a simple membrane, or largely desclerotised ventrally giving the aedeagus a frame-like shape [1]. The ejaculatory duct

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enters the aedeagal tube through the basal orifice. It goes out from the ostium (apical orifice) which is, exceptions, situated on the dorsum of the median lobe near the apex [6].

The tegmen consists of a flattened and usually bilobed tegminal plate, V-shaped basal piece and an apodeme (Manubrium) [1]. The tegmen located the basal part of median lobe (called "aedeagal tube" by Wanat [1]) form a ring. In some groups, dorsal part of tegmen is reduced, and the tegmen is not enveloping the aedeagal tube [6]. The function of the weevil tegmen is primarily mechanical in two respects. First, the tegmen limits the range of eversion of the aedeagus and serves as a point of attachment for the post-tegminal membrane. Second, it assists with eversion and retraction of the genitalia through the action of the muscles attached to the apodeme [1].

The 9th sternite (spiculum gastrale) in different shapes is originated 9th abdominal sternite [6] and used a special taxonomic character for species by many researchers [7]. Typically, S9 has a single basal plate or fork with a single apodeme, both situated ventrally. The basal plate is attached to the genital membrane in its normal, ventral position. However, the fork is largely asymmetrical, with one arm vestigial, and the other long and strictly an extension of a long apodeme directed laterad [1].

Herein, we presented details of the genitalia of male *Lixus nordmanni* Hochhuth, 1847 (Curculionidae: Lixinae) by optical microscopy and scanning electron microscopy (SEM).

2. MATERIALS AND METODS

Several specimens were selected from dried museum materials. The male genitals were prepared by first softening the abdomen in 10% KOH for 24 hours at 30°C. Thereafter, tissues were carefully removed and the male genitals were placed in glycerin. Observation was made using a stereomicroscope (Olympus SZX12 Photomicroscope at 40X). For scanning electron microscope (SEM), rinsed and dried male genitals were

mounted with double-sided carbon tape on SEM stubs, coated with gold in a Polaron SC 502 Sputter Coater, and examined with a JOEL JSM 6060 SEM operated at 15 kV.

Nomenclature follows Tuxen [6]; Wanat [1], and classification follows Alonso-Zarazaga and Lyal [8].

3. RESULTS

3.1. Aedeagus

The male genitalia characterised by aedeagus and 9th sternite (Figure 1A). The aedeagus consists of two main parts; aedeagal tube and tegmen which are connected by the first connecting membrane. In lateral view, the aedeagal tube is bended at the basal part (Figure 1A) and its lateral surface (called "aedeagal pedon" by Wanat [1]) strongly sclerotised that has many granules (Figure 1B-C). The apical part of aedeagal tube is clearly narrowed. It has a swollen membranous which seems slightly under the light microscope (Figure 1A-B). In dorsal view, the aedeagal tube is slightly narrowed basally (Figure 1D), its apex is widen dorsally (Figure 1E), the apical part of aedeagal tube has a big ostium which from endophallus (internal sac) goes out, (Figure 1F). There is a long and deep split on dorsal surface (Figure 1G). In the basal of aedeagal tube, the tegmen is located like a ring (Figure 1H). It is widen at the dorsal part (Figure 2A) and its surface appears porously (Figure 2B). The manubrium seems long and smooth, and strongly sclerotised. Its apex is curved and flatness (Figure 2C). The aedeagal apodemes appear symmetrically and strongly sclerotised. It is widen at the apex (Figure 2D).

3.2. 9th Sternite (*Spiculum gastrale*)

The 9th sternite seems T-shaped (Figure 1A). It is very thin and long, and its apex connected the wide plate which is convex (Figure 2E). The surface of plate has many pores (Figure 2F). The 9th sternite seems like a bow (Figure 1A). Its surface is strongly sclerotised (Figure 2G). Basally, it is curved and flattened (Figure 2H).

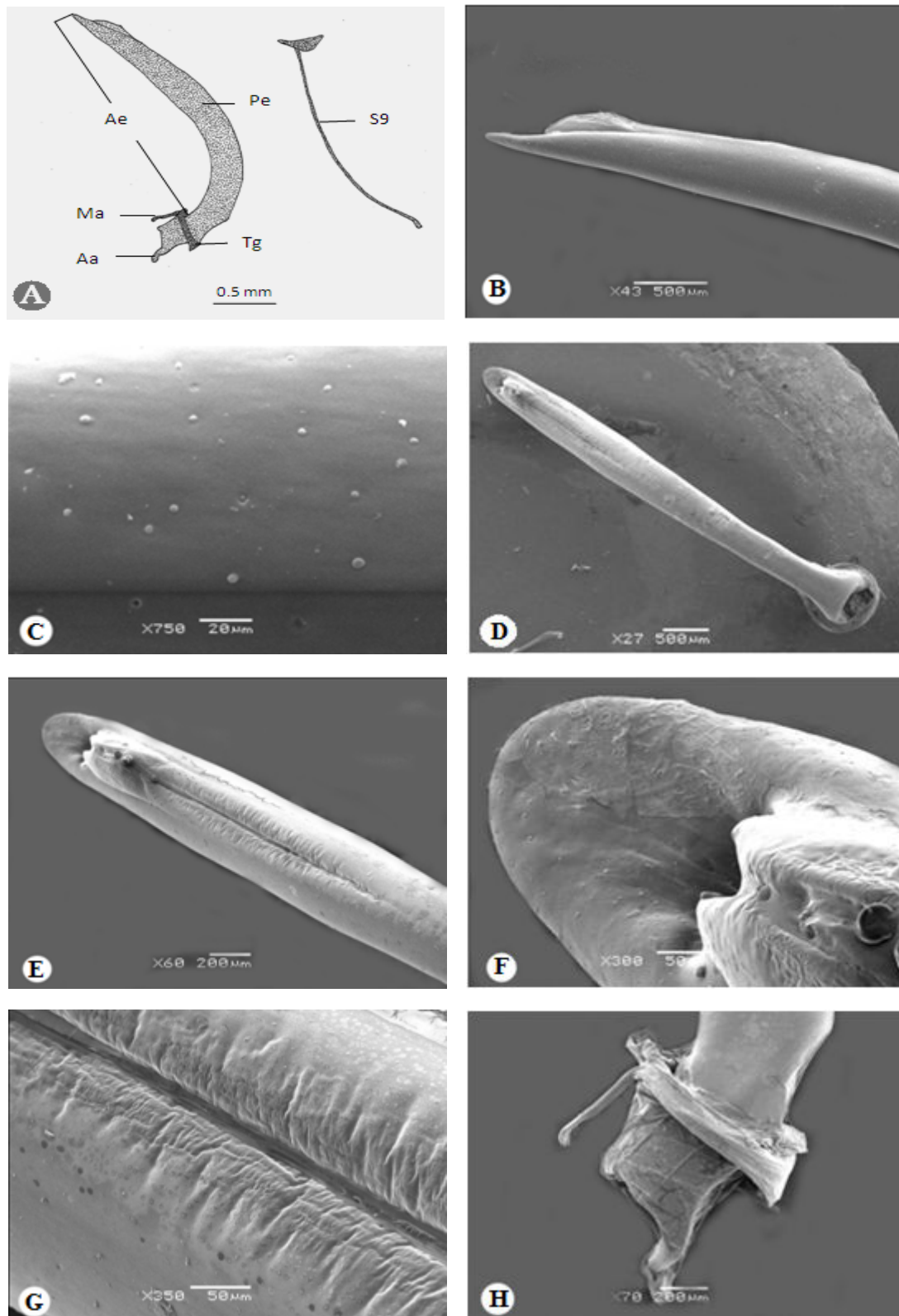


Figure 1. Drawing and SEM photos of male genitalia of *Lixus nordmanni*: A- drawing of the aedeagus (in lateral view) and 9th sternite; Aa: Aedeagal apodemes, Ad: Aedeagus, Ae: Aedeagal tube, Tc: Aedeagal tectum, Ma: Manubrium, Os: Ostium, Pe: Aedeagal pedon, S9: 9th sternite, Tg: Tegmen; B- the lateral view of aedeagal tube; C- the surface of aedeagal pedon; D- the dorsal view of aedeagal tube; E- the dorsal view of aedeaga pedon; F- the ostium on apical of aedeagal tube; G- the view of canal on dorsal surface of aedeagal tube; H- the view of tegmen.

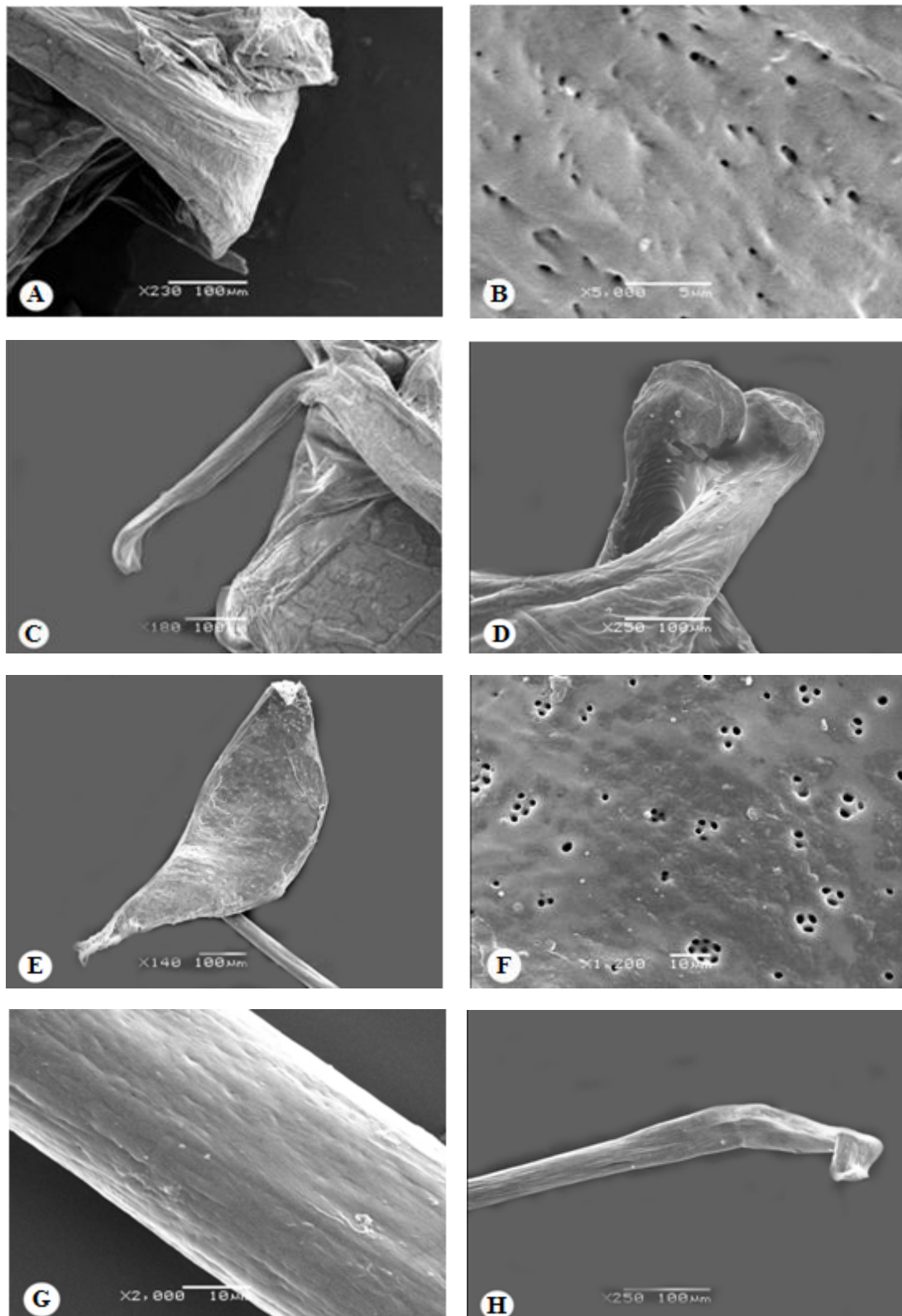


Figure 2. SEM photos of male genitalia: A- the dorsal part of tegmen; B- the surface of tegmen; C- the manubrium; D- the aedeagal apodemes; E- the apex of 9th sternite; F- the surface of plate; G- the surface of long body; H- the basal part of 9th sternite.

4. DISCUSSION

The male genital structures of *Lixus nordmanni* Hochhuth, 1847 (Curculionidae: Coleoptera) were examined by light and scanning electron microscope, and provided all details. We were first drawn genitalia and showed the chitinisation and sculpture of structures in *L. nordmanni*. The morphological characters as the presence of aedeagus and 9th sternite are important in classification higher at the generic level of the Curculionidae were established. The structures of genitalia seem limited under the light microscope. The chitinisation and sculpture of structures are not appear sufficiently in light microscope, but in SEM, the chitinisation which has structures like spines, tubercles, pits or folded, and sculpturing seem clearly.

The male genitalia have been recognised by several authors for diagnosis of species level. Tuxen [6] stated that the male genitalia is annulated in family Curculionidae. The male genitalia of the several genus (including *Lixus*) of subfamily Lixinae (Curculionidae) were examined by Sert and Çağatay [9], who recognised the genital structures and compared shapes or size of structures among species. Ter-Minasyan [10] examined to the subfamily Lixinae, and drawn genitalia of some species but did not examine the genitalia of *L. nordmanni*.

Several authors compared shapes or size of structures among species and obtained details used in distinguishing at the species level [1, 6, 9, 11-13]. However, the chitinisation and sculpturing of structures may important as well as shapes and size. The sculpturing of different shapes and structures may provide distinctive characteristics for some of the species, and especially use separate relative species. This study showed that the male genital structures have more different morphological characters in Curculionidae (Coleoptera) and need to more work in SEM for expose to characters.

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