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External Morphology of the Female Genitalia of *Lixus nordmanni* Hochhuth, 1847 (Coleoptera: Curculionidae, Lixinae): A Scanning Electron Microscope Study

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ABSTRACT

The female genitalia of *Lixus nordmanni* Hochhuth, 1847 (Coleoptera: Curculionidae) were examined by light and scanning electron microscope (SEM). A detailed description about it is provided. The female genitalia comprise spermatheca, genital spicule, 8th abdominal sternite and ovipositor. The spermatheca consists of reservoir, spermathecal duct and accessory gland. It seems like a hook shape. Its surface is strongly sclerotised. The genital spicule is much shortened and the 8th abdominal sternite like V-shaped. The ovipositor (sternites) organ appears symmetrically swollen tube.

Key Words: Coleoptera, Curculionidae, *Lixus nordmanni*, Female genitalia, SEM

1. INTRODUCTION

The female genital organs in the Curculionidea are constituted by the 8th and 9th abdominal segments, as in other Coleoptera [1]. The 8th segment is usually reduced and its sternite is usually assosiated with a chitinous apodeme of variable size and shapes. Such an apodeme has also been reporded in a number of other families of Coleoptera but has not received a definite name so far. It is accordingly designated as "genital spicule". The 9th segment forms a short or long tube and its sternum generally bears a pair of short or long sternites each with or without a stylus [1]. Stylus has normally sensorial function (armed with bristles) [2, 3]. The sclerites of the 9th abdominal segment (genital segment) form an important part of the external genitalia of the female.

The tergite of this segment is usually not much modified whereas the sternite as a rule is divided into a pair of "hemisternite" (it is modified "sternite") which usually bears an arculating process, the stylus. The ovipositor consists of the two hemisternites which are prolonged, arcuate and fused together dorsally, or it is formed by the stretched 8th and 9th abdominal segments [2].

The spermatheca is strongly sclerotised since it has ectodermal origin; this arrangement is common in all coleopterans [4]. It opens to the anterior tract of the common oviduct of the female insects [5]. Sperm stored within the spermatheca pass through the spermathecal duct into the bursa copulatrix where the eggs are fertilized [6]. Spermatheca which often possesses strongly scletorized walls, may be of great value for to distinguish the species in many critical genera. Accesory gland is regularly attached to the spermatheca [2]. The accessory gland secretion of insects is involved in spermatozoa activation, spermatozoa transfer to the spermatheca, and maintenance of spermatozoa [5, 7, 8].

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Secretory activity is increased once spermatozoa reach the spermatheca, and spermatozoa remain viable for several months following insemination [9].

2. MATERIALS AND METODS

Several specimens were selected among the dried materials. The female genitals were prepared by first softening the abdomen in 10% KOH for 24 hours at 30^0C. Thereafter, tissues were carefully removed in 70% alcohol and the female genitals were placed in glycerin. Observation was made using a stereomicroscope (Olympus SZX12 Photomicroscope at 40X). For scanning electron microscope (SEM), rinsed and dried female 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.

In nomenclature were followed the literatures of Tuxen [2]; Pajni et al. [10]; and in classification was used the reference of Alonso-Zarazaga and Lyal [11]. A list of abbreviations is given in Table 1.

Table 1. Abbreviations used in figures of the female genital structures.

Ag	Accesory Gland
As	Abdominal Sternite
Gs	Genital Spicule
Ovip	Ovipositor
Sd	Spermathecal Duct
Sp	Spermatheca
Sty	Stylus

3. RESULTS

3.1. Spermatheca

The spermatheca consists of receptaculum seminis, spermathecal duct and accesory gland (Figure 1A). It resembles a hook shape and strongly sclerotised (Figure 1A, B). Its apex is narrowed and distinctly inward curved (Figure 1B). Basally, the ventral side of spermatheca has many curls. The spermatheca widen as a sac at the basal part (Figure 1C). The spermathecal duct is very thin, and its surface with irregularly structure (Figure 1D). The accesory gland is opened to the dorsal of the spermatheca with a short duct which of surface is porously (Figure 1E, F). It appears slightly membranous in light microscope (Figure 1A). But, in insemination of SEM, its surface is little sclerotised which has irregularly structure (Figure 1E).

3.2. Genital Spicule and 8th Abdominal Sternite

The female genital of *Lixus cardui* has the genital spicule and 8th abdominal sternite which is joined (Figure 2A, B). The genital spicule triangular and seems as very short and strongly sclerotised (Figure 2B). The length of genital spicule is 80.4 µm; its diameter 36.2 µm. The 8th abdominal sternite appears like V-shaped. The lateral sides of abdominal sternite are strongly sclerotised and in median with membranous fold (Figure 2B). It has two plates which are joined with a membranous at the basal part (Figure 2C). It is strongly sclerotised and little convex in front surface which has many porous and long hairs (Figure 2E).

The 8th abdominal sternite has many structures that like a funnel shape on back surface (Figure 2D). There are many long fibrils among the funnel structures (Figure 2F). The length of 8th abdominal sternite is 648 µm; its diameter 485µm.

3.3. Ovipositor

The ovipositor which has two hemisternites seems in Figure 3A. It is originated by the 9th abdominal sternum. The sternites appear a swollen tube shape which are strongly sclerotised, and distinctly narrow at the apical part (Figure 3A, B). Each sternite bears the stylus which armed with bristles (Figure 3C). The stylus like a short tube that has many long bristles at the apex (Figure 3D). The length of stylus is 86.1µm; its diameter 28.6 µm. The front surface of sternites appears porously (Figure 3E). The back surface is strongly sclerotised which seems twisted structure (Figure 3F). The length of ovipositor is 612µm; its diameter 432µm.

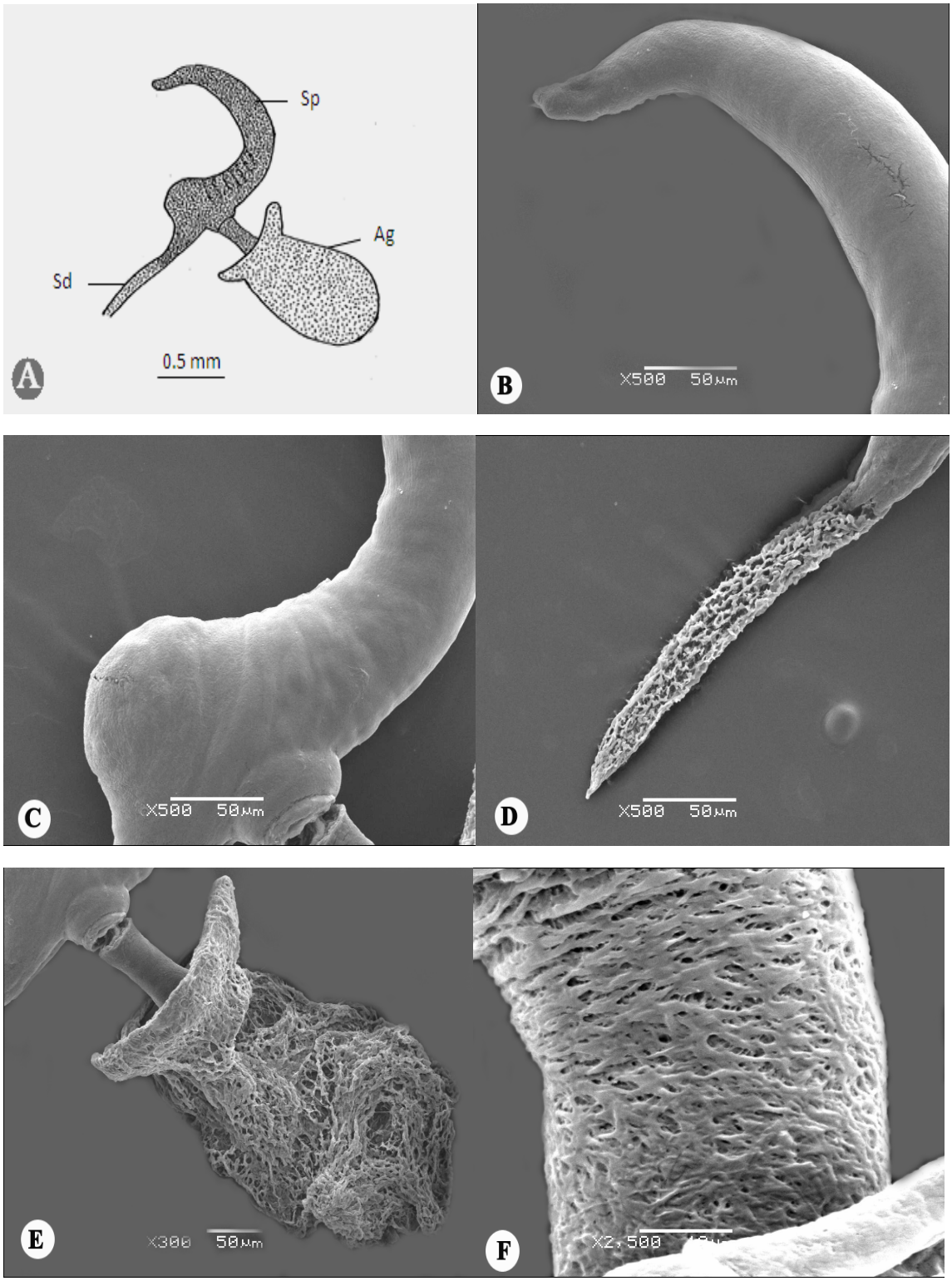

Figure 1. Drawing and SEM photo of female genitalia of *Lixus nordmanni*: A- drawing of the spermatheca; B-the apical part of spermatheca; C-the basal part of spermatheca; D-the spermathecal duct; E-the accessory gland with a short duct; F-the duct of accessory gland.

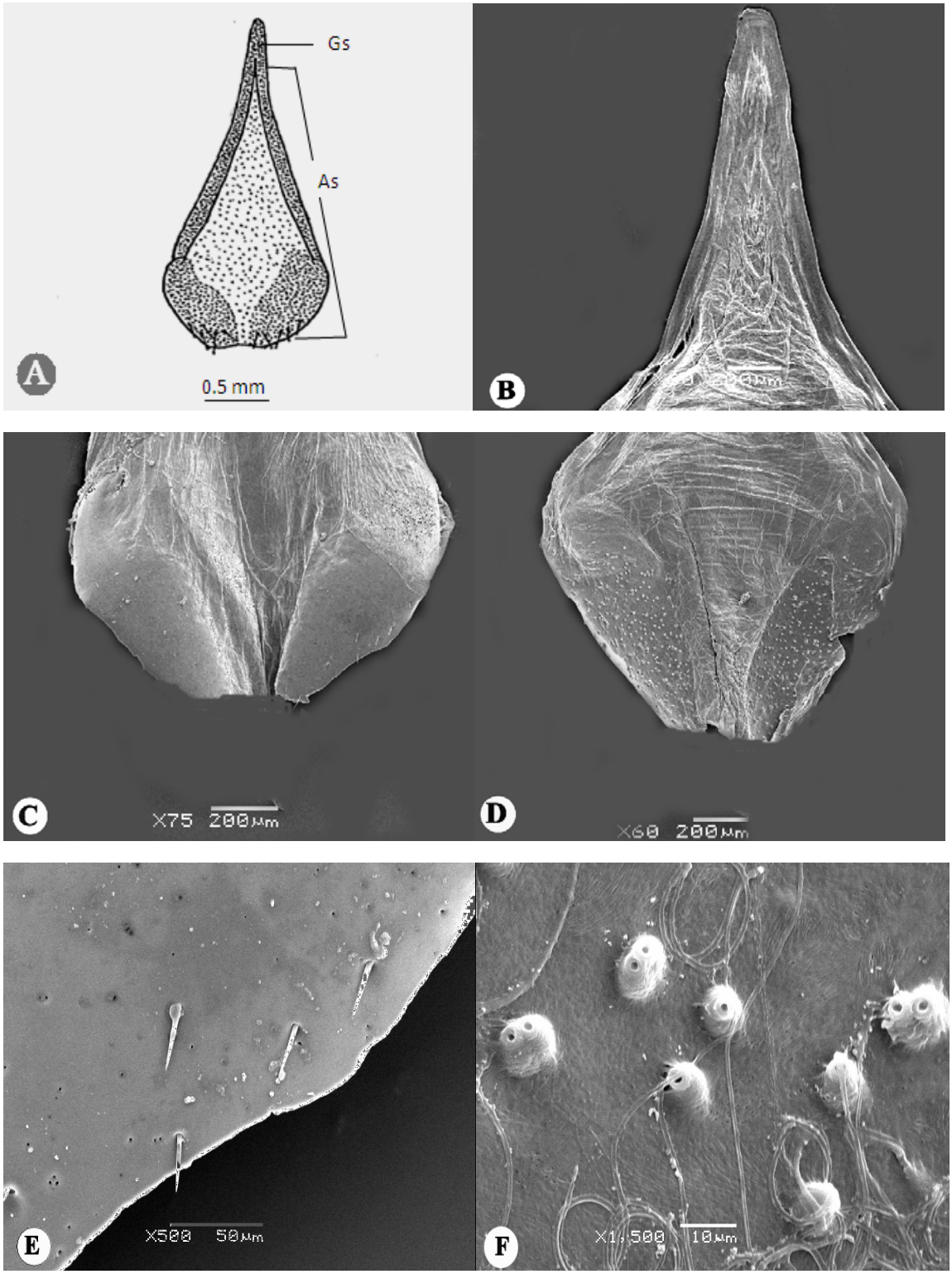

Figure 2. Drawing and SEM photos of genital spicule and 8th abdominal sternite: A- drawing of genital spicule and abdominal sternite; B- view of apical part of abdominal sternite; C-the front surface of abdominal sternite; D- the back surface of abdominal sternite; E-the some porous and hairs on front surface of abdominal sternite; F- view of funnels and fibrils on back surface of abdominal sternite.

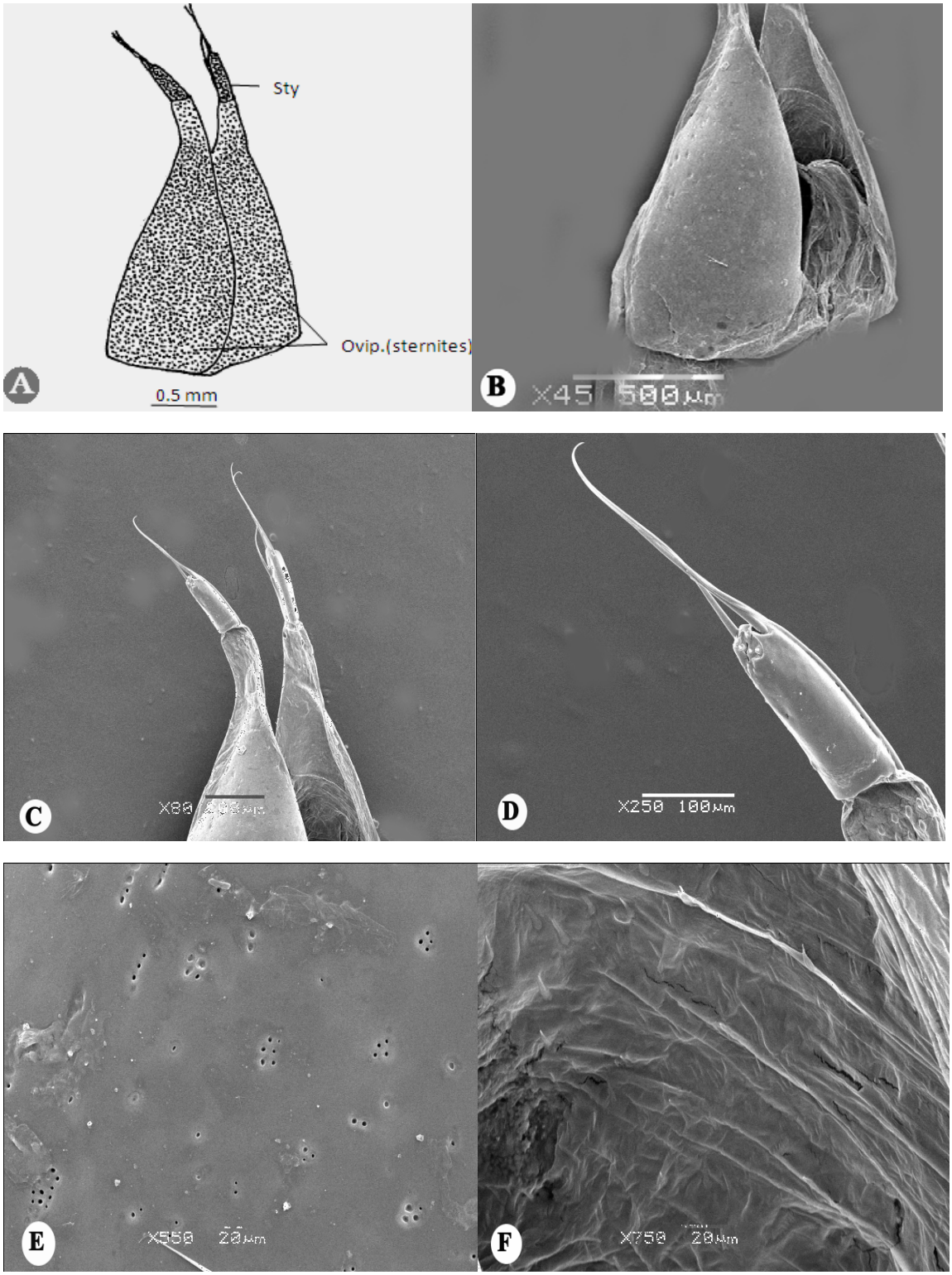

Figure 3. Drawing and SEM photos of the ovipositor. A- drawing of sternites of ovipositor and stylus; B- the apical part of sternites and stylus; C-median and basal part of sternites; D-stylus and hairs on apical part; E-the front surface of sternites; F-the back surface of sternites.

4. DISCUSSION

The female genitalia have been recognized as source of taxonomically important characters in Coleoptera by many authors, who compared the shape and size of the genital structures for species diagnoses. Tanner [1] gave a comparative account of the female genitalia in Coleoptera. Aslam [12] explain that the spermathecal

structures in the family Curculionidae to be highly distinctive at the specific level. Morimoto [13] gave an outline of the female genital structures in the different families of Curculionidea and discussed their structure in the subfamilies Otiorrhynchinae and Sitoninae. Stone et al., [14] examined the reproductive system of *Graphognathus* (Curculionidae) and stated that the spermatheca, ovipositor styli and 8th abdominal sternite may provide good taxonomic characters for the genus. Pajni et al., [10] examined the female genitalia of several subfamily of Curculionidae (including Lixinae) and stated the genitalia of individual species under different subfamilies, however can be easily separated on the basis of the shape and the size of different constituents. Sert [15] examined the female genitalia of the subfamily Lixinae (Curculionidae) and recognised the structures which include systematics characters like spermatheca, genital spicule, 8th abdominal sternite and ovipositor organ.

In this study, the female genital structures of *L. nordmanni* Hochhuth, 1847 (Coleoptera: Curculionidae) were examined by light and scanning electron microscope, and provided all details. The morphological characters as the presence of spermatheca, genital spicule, 8th abdominal sternite and ovipositor are important in classification higher at the generic level of the Curculionidae were estabilished. The structures of genitalia seem limited under the light microscope. The chitinisation and sculpturing of structures are not appear sufficiently in light microscope, but in SEM, the chitinisation which has structures like spines, tubercules, pits or folded, and sculpturing seem clearly.

We were apparently showed the chitinisation and sculpture of structures in *L. nordmanni*. Several authors compared shapes or size of structures among species and obtained details used in distinguish at the species level [10, 15, 16, 17, 18, 19]. 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. The survey revealed a wide variety of morphological characters of female genitalia in Curculionidae. More work involved in SEM is needed to established clear trends within the taxonomic groups.

REFERENCES

[1] Tanner, V. M., "A preliminary study of the genitalia of female Coleoptera," ***Trans. Amer. Ent. Soc.***, 53:5-50, (1927).

[2] Tuxen, S. L., "Taxonomist's Glossary of Genitalia in Insects," Scandinavian University, Munksgaard, Copenhagen, 1-215, (1970).

[3] Ellsbury M. M., Baker, G. T., "Biological and morphological aspects of the egg stage and oviposition of *Languria mozardi* (Coleoptera: Languriidae)," ***Proceed. Entomol. Soc. Wash***, 91: 9–14 (1988).

[4] Crowson, R. A., "The biology of the Coleoptera," ***Acad. Press***, London, 802, (1981).

[5] Davey K. G., Webster, G. F., "The structure and secrection of the spermatheca of *Rodnius proxilus* Stal: A histochemical study," ***Can. J. Zool.***, 45: 653-657 (1967).

[6] Khan N. R., Musgrave, A. J., "Observations on the functional anatomy of the reproductive organs of *Sitophilus* (Coleoptera: Curculionidae)," ***Can. J. Zool.***, 47: 665–669 (1969).

[7] Bhatnagar R. D., Musgrave, A .J., "Aspects in histophysiology of the spermathecal gland of *Sitophilus granarius* (L) (Coleoptera)," ***Can. J. Zool.***, 49: 275-277, (1971).

[8] Grodner M. L., Steffens, W. L., "Evidence of a chemotactic substance in the spermathecal gland of the female boll weevil (Coleoptera: Curculionidae)," ***Trans. Amer. Micros. Soc.***, 97:16- 120, (1978).

[9] Barker, G. M., "Functional anatomy of the reproductive system of *Listronotus bonariensis* (Kuschel)," ***New Zeal. Entomol.***, 12: 34-42 (1989).

[10] Pajni, H. R., Singal S. K., Bhateja, B. R., "A study of female genitalia in the families Curculionidae, Brentidae and Attelabidae (Coleoptera: Curculionidae)," ***Resear. Bull.***, Panjab University, 28: 69-83, (1977).

[11] Alonso-Zarazaga M. A., Lyal, H. C., "A World Catalogue of Families and Genera of Curculionoidea (Insecta: Coleoptera) (Excepting Scolytidae and Platypodidae)," ***Entomop.***, Barcelona, Spain, 1-315, (1999).

[12] Aslam, N. A., "An assessment of some internal characters in the higher classification of the Curculionidae," ***Trans. Roy. Ent. Soc. Lon.***, 113: 41 7-480, (1961).

[13] Morimoto, K., "Comparative Morphology and Phylogeny of the Superfamily Curculionoidea of Japan," ***J. Fac. Agr.***,, Kyushu University, 11: 331-373, (1962a).

[14] Stone, M. J., Hermann H. R., Brady, U. E., "A Comparative Study of the Reproductive System of Three Species of *Graphognathus* (Coleoptera: Curculionidae)," ***Ann. Ent. Soc. Amer.***, 64: 708-718, (1971).

[15] Sert, O., "Investigations on the female genital organ structure in Cleoninae (Coleoptera)," ***Turk. J. Entomol.***, 21:147- 159, (1997).

[16] Pesarini, C., "Le specie paleartiche occidentalli della tribü Phyllobiini (Coleopera: Curculionidae)", ***Boll. Zool. Agr. Bachic***., 2 (15): 49-230 (1979).

[17] Caldara, R., "Revision della *Sibinia* palearctiche (Coleoptera, Curculionidae), ***Estr. Mem. Soc. Entomol. Ita***., 62/63: 24-105 (1984).

[18] Caldara, R., "Revision taxonomica della specie paleartiche del genere *Tychius* Germar (Coleoptera: Curculionidae)", ***Mem. Soc. Ital***., 25 (3): 45-217 (1990).

[19] Sert, O., "The female genital structures of several species of the genus *Cionus* Clairville, 1798 (Coleoptera: Curculionidae)", ***Zootaxa***, 1412: 55-60 (2007).