

MORPHOLOGY OF OVIPOSITORS AND SPERMATHECAE OF REPRESENTATIVES OF DEXIINI TRIBE (DIPTERA, TACHINIDAE) OF THE FAUNA OF UKRAINE

S. Farynets

Морфологія яйцекладів і сперматеків представників триби Dexiini (Diptera, Tachinidae) фауни України. – Фаринець С. – Робота присвячена вивченню геніталії триби Dexiini та личинок 1-го віку. Проведено дослідження морфології склеротизованих структур постабдомену самок, сперматеків, личинок першого віку представників триби Dexiini. Метою роботи є оцінити можливість використання морфології цих структур у систематиці. На сонові отриманих результатів можна зробити висновок щодо цінності цих ознак для встановлення систематичної належності. Дослідження змін статевої структури самок Dexiini проводили на матеріалі, який охоплює 11 видів з 7 родів. Результати вивчення морфологічних ознак постабдоменальних, сперматеків та личинок першого віку дозволяють обґрунтовано інтерпретувати диференціацію таксонів родового рівня. В роботі наведено таблиці для визначення видів триби Dexiini.

Ключові слова: Tachinidae, постабдомен, статева структура, таблиці для визначення, ідентифікація.

Адреса: кафедра зоології, Ужгородський національний університет, вул. А. Волошина, 32, Ужгород, Україна, email: stepan.farinets@uzhnu.edu.ua

Morphology of ovipositors and spermathecae of representatives of Dexiini tribe (Diptera, Tachinidae) of the fauna of Ukraine. – Farynets S. – The paper devoted to the study of genitalia of Dexiini tribes and larvae of the 1st century in order to evaluate the possibility of using these structures in taxonomy. The study of the morphology of sclerotized structures of the postabdomen of females, spermathecae, first-instar larvae of representatives of the tribe of Dexiini was conducted. They indicated the value of these features for taxonomy. The studied changes in the genital structures of females Dexiini were carried out on a material that covers 11 species of 7 genera. The results of the study of morphological signs of postabdomen, spermathek, and first-instar larvae allow reasonably interpreted differentiation of taxa of generic level. Keys for species identification is presented.

Key words: Tachinidae, postabdomen, genital structures, keys, identification.

Address: Uzhhorod National University, Department of Zoology, Voloshyna str., 32, Uzhhorod, Ukraine, 88000; email: stepan.farinets@uzhnu.edu.ua

Introduction

Since the very beginning of the study of tachina flies, scholars have been facing the problem of isolation of high-rank taxons and elucidation of kindred relationship between them. Some well-known Dexiinae systems, mainly those based on the data of external morphology and male postabdomen and studied for over a hundred years, female genitalia and first-instar larvae – whose structure could expand our knowledge of tachina systems – have mostly been neglected so far. We are aware of only few works dedicated to this problem (Thompson 1923; 1924; 1926; Herting 1957; 1960; 1984; Hori 1961; O'Hara 1987; Tachi, Sima 2000; Stireman et al. 2006; Richter, Farinets 1979; 1983; 1989; 1996; Richter 1987; 1988; Farinets 1976; 1980; 2002; 2003; 2008; 2017). Because of that, we co-studied ovipositors, spermathecae and first-instar larvae to obtain additional data to interpret the phylogeny and

taxonomy of Dexiini tribe. As a result of the study, new information was obtained that enabled to better understand the taxonomy of some problematic groups of tachina flies.

Different scholars have treated the Dexiinae system differently. In particular, Hering (1984) distinguished the following three tribes within the subfamily: Dexiini, Voriini, Dufouriini. Based on the analysis of imagoes and first-instar larvae morphology, V. Richter (1988) singled out the Voriinae subfamily within Dexiinae, and limited the latter to two tribes only: Trixini and Dexiini.

In Dexiini, hosts may become infected with the help of a planidium-shaped first-instar larva that actively seeks for beetles from the following families: Scarabidae, BUPRESTIDAE, CERAMBICIDAE, LUCANIDAE, CARABIDAE, CURCULIONIDAE, HEPIALIDAE, TENEBRIONIDAE (Tshorsnig, Herting 1994).

The aim of the study was to identify the morphological rows of the characteristics of female

and first-instar larvae's genitalia for the purpose of further interpretation of kindred relationship between them.

Materials and methods

The material for analysis of female postabdomen and spermathecae was taken in the Ukrainian Carpathians; the first-instar larvae were obtained from different Palaearctic regions (Richter, Farinets 1983). The material was prepared following the methods described by Grunin (1948), Farinets (1977; 2008). According to Herting (1984), Dexiini tribe is composed of 12 genera, of which 7 species were studied, viz.: ovipositors of 9 species, spermathecae of 7 species, and first-instar larvae of 20 species.

Results

Trixa Meigen, 1824. The spermatheca ducts flow into the vagina as one common short channel that joins them with the vagina (Fig. 1: C). The spermatheca capsules are oblong-oval in profile; one side of the capsule is convex, and the opposite one is flat; both are pigmented, with expressed cross stripes. The length of the spermatheca capsules is bigger than that of the spermatheca ducts. The accessory glands are connected with the vagina with thin channels, strongly widened towards the top; their length is somewhat bigger than that of the spermathecae.

The first-instar larvae were described by Richter, Farinets (1983).

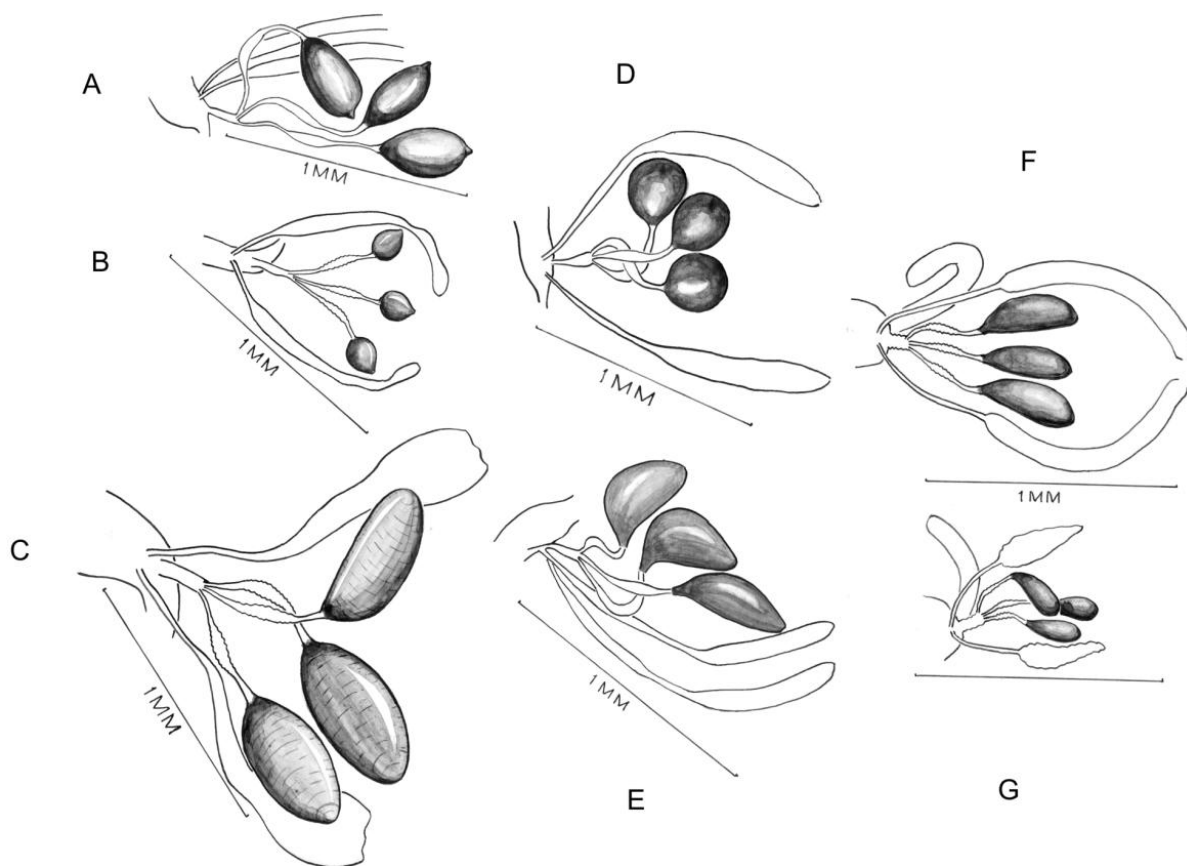


Fig. 1. Dexiini spermathecae: A – *Billaea adelpha* Loew., B – *Dinera grisescens* Fll., C – *Trixa caeruleascens* Mg., D – *Estheria cristata* Mg., E – *Billaea pectinata* Mg., F – *Dinera ferina* Fll., G – *Dinera carinifrons* Fll.

The postabdomen tergites VI, VII are unparted, with different-length bristles along the back part. The tergite VIII is unparted and without bristles. The final tergite is fully reduced. The back part of the sternite VI has bristles. The sternites VII, VIII are polygonal, with bristles along nearly

entire surface. The spiracles of the segments VI, VII are located on the membrane (Fig. 2).

Billaea Robineau-Desvoidy, 1830. The spermatheca ducts flow into the vagina as one common short channel that joins them with the vagina (Fig. 1: A, E). The spermatheca capsules are oblong-oval in profile; one side of the capsule is

convex, and the opposite one is flat in *B. pectinata* (Meigen, 1826); both are pigmented, sharp at the top (*B. adelpha* (Loew, 1873), without cross stripes (Fig. 1: A). The length of the spermatheca ducts is bigger than that of the spermatheca capsules. The accessory glands are connected with the vagina with short (*B. adelpha*) and thin channels nearly as far as the middle of the glands (*B. pectinata*), which are widened towards the top; their length is somewhat bigger than that of the spermathecae.

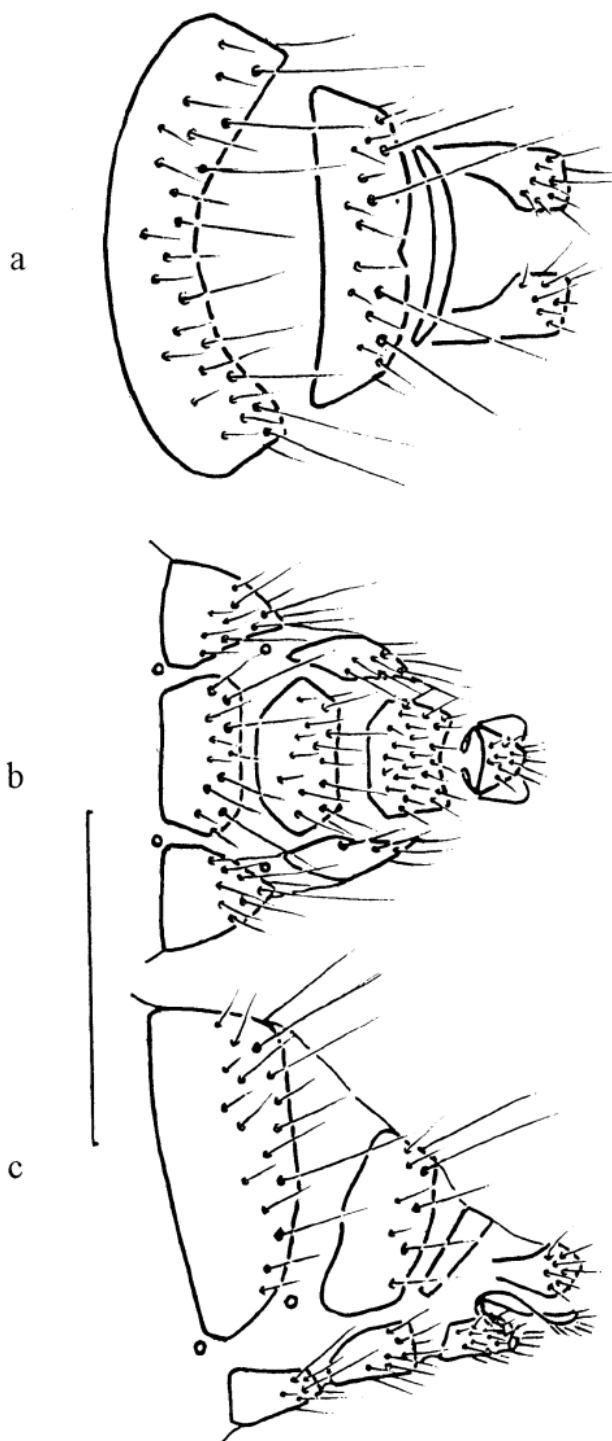


Fig. 2. Postabdomen of *Trixa caerulea* Mg. (a – dorsal view, b – abdominal view, c – lateral view).

The first-instar larvae were described by Richter and Farinets (1983).

The postabdomen tergites VI, VII are unparted, with different-length bristles along the back part. The tergite VIII and the final tergite are fully reduced. The sternite VI is widened towards the back edge, with bristles along the back part. The sternite VII has bristles. The sternite VIII is somewhat narrowed towards the back edge, with bristles along the entire surface. The spiracles of the segments VI, VII are located on the tergite VI (*B. pectinata*), or on the membrane in *B. adelpha* (Fig. 3, 4).

Dinera Robineau-Desvoidy, 1830. The spermatheca ducts flow into the vagina as one common short channel that joins them with the vagina (Fig. 1: B, F, G). The spermatheca capsules are oblong-oval in profile; one side of the capsule is convex, and the opposite one is flat in *D. ferina* (Fallén, 1817). Both are pigmented, without cross stripes. The length of the spermatheca capsules is somewhat bigger than that of the spermatheca channels (*D. ferina*, *D. carinifrons* (Fallén, 1817)). The spermatheca capsules of *D. grisea* (Fallén, 1817) are pear-shaped; their length is 2.5 times less than the spermatheca channels. The accessory glands are connected with the vagina with thin channels nearly as far as the middle of the glands, which are widened towards the top; their length is somewhat bigger than that of the spermathecae.

The first-instar larvae have been described (Farinets 1980; Richter, Farinets 1979; 1983).

The postabdomen tergites VI, VII are unparted, with a row of different-length bristles along the back part (Fig. 5, 6, 7). The tergite VIII is unparted and without bristles (*D. grisea*), or strongly reduced and divided into two little sclerites (*D. carenifrons*, *D. ferina*). The back part of the sternites VI, VII has bristles. The width of the sternite VII is bigger than that of the sternite VI. The surface of the sternite VIII is fully covered with bristles. The spiracles of the segment VI of *D. ferina*, *D. grisea* are located on the tergite VI of this segment; those of the segments VI, VII of *D. carinifrons* are located on the membrane (Fig. 5, 6, 7).

Estheria Robineau-Desvoidy, 1830. The spermatheca ducts flow into the vagina as one common short channel that joins them with the vagina (Fig. 1: D). The spermatheca capsules are pear-shaped in profile, pigmented, without cross stripes. The length of the spermatheca ducts is nearly 1.5 times bigger than that of the spermatheca

capsules. The accessory glands are connected with the vagina with thin channels nearly as far as the middle of the glands, which are widened towards the top; their length is somewhat bigger than that of the spermathecae.

The first-instar larvae were described by Richter and Farinets (1983).

The postabdomen tergite VI is unparted, with one or two rows of different-length bristles along the back part. The tergite VII is unparted with a row of bristles (*E. petiolate* (Bonsdorff, 1866); in

E. cristata (Meigen, 1826) it is dorsally divided into two sclerites with 4 or 5 bristles on the back edge. The tergite VIII is dorsally divided into two little sclerites without bristles. The final tergite is fully reduced. The sternites VI, VII are widened towards the back edge, with bristles along it (*E. cristata*); *E. petiolate* has cross-oval sternites with bristles along the back edge. The surface of the sternite VIII has bristles along the entire surface. The spiracles of the segments VI, VII are located on the membrane (Fig. 8, 9).

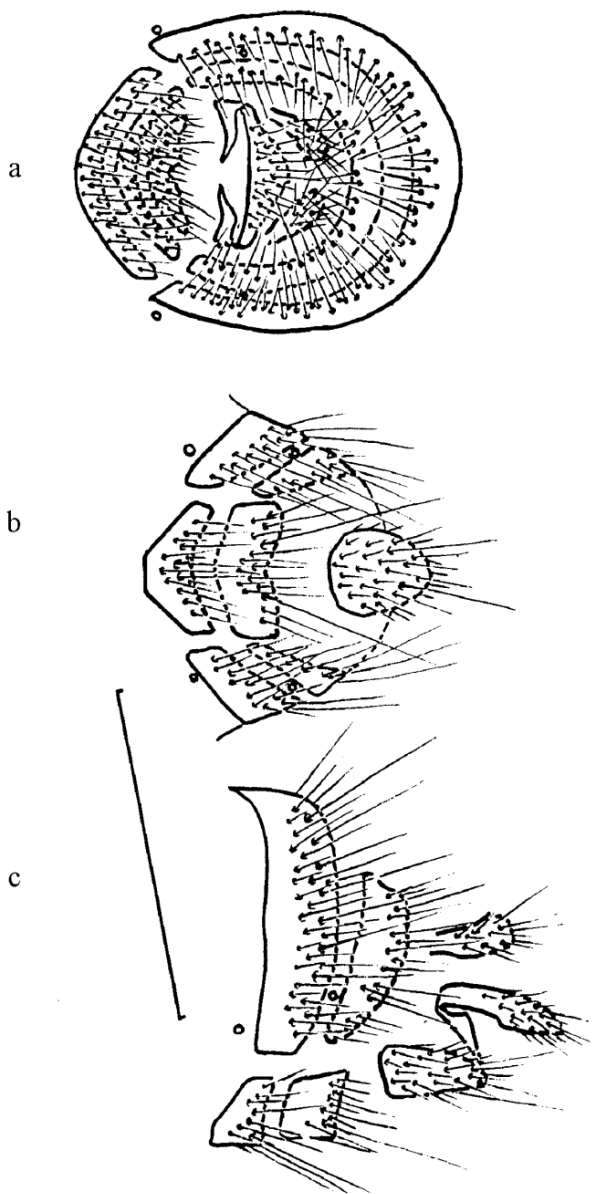


Fig. 3. Postabdomen of *Billaea adelpha* Loe. (a – dorsal view, b – abdominal view, c – lateral view).

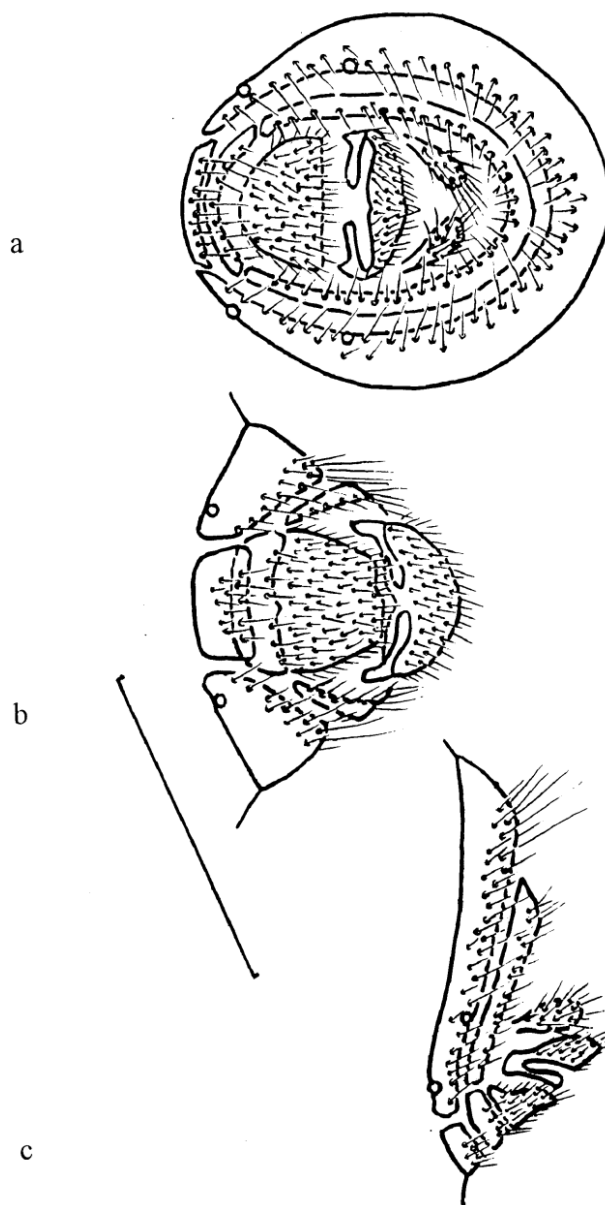


Fig. 4. Postabdomen of *Billaea pectinata* Mg. (a – dorsal view, b – abdominal view, c – lateral view).

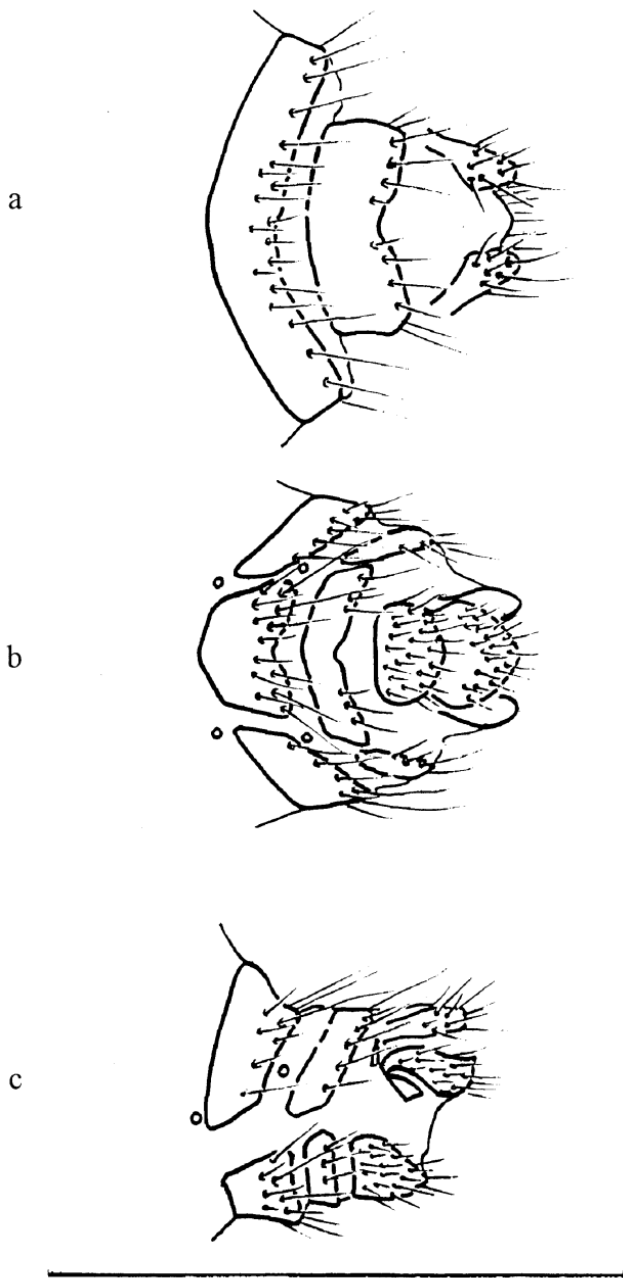


Fig. 5. Postabdomen of *Dinera carinifrons* Fll. (a – dorsal view, b – abdominal view, c – lateral view).

***Dexia* Meigen, 1826.** No spermathecae have been described so far. The first-instar larvae were described by Richter and Farinets (1983).

The postabdomen tergites VI, VII are unparted, with a row of different-length bristles along the back edge. The tergite VII and the final tergite are fully reduced. The sternite VI is widened

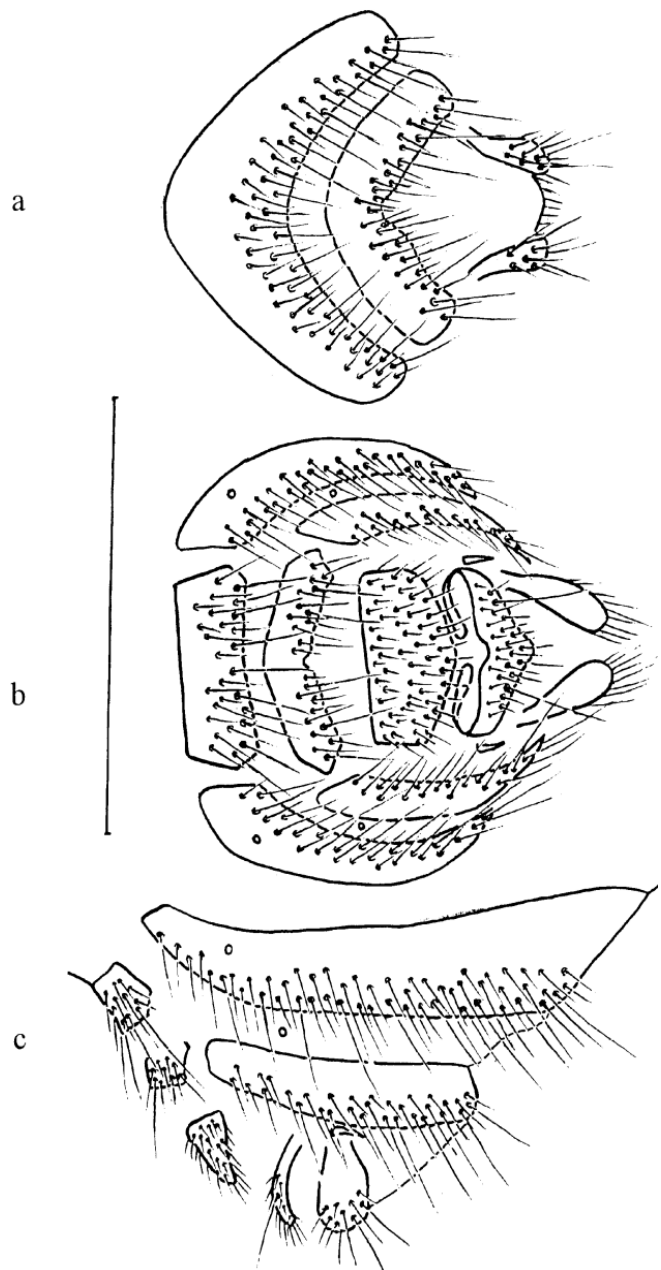


Fig. 6. Postabdomen of *Dinera ferina* Fll. (a – dorsal view, b – abdominal view, c – lateral view).

towards the back edge, with bristles along it. The sternite VII is cross-oval, with a row of bristles along the back edge. The sternite VIII is cross-oval, with bristles along the entire surface; this is the widest sternite. The spiracles of the segments VI, VII are located on the tergites of the respective segments (Fig. 10).

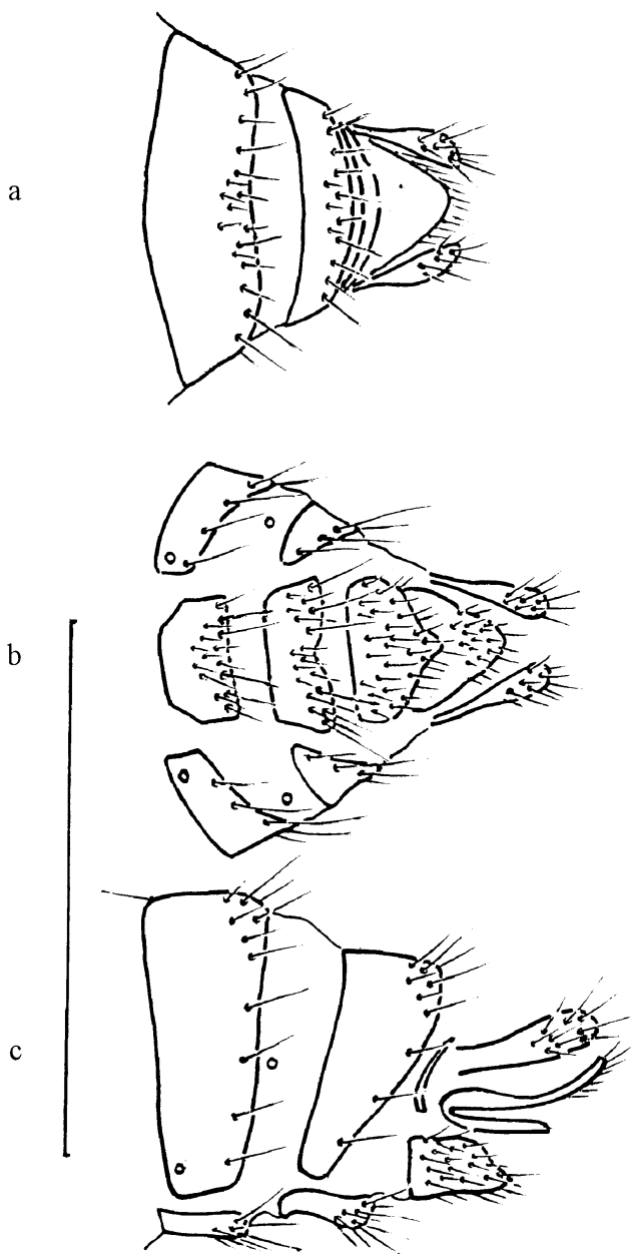


Fig. 7. Postabdomen of *Dinera grisea* Fll. (a – dorsal view, b – abdominal view, c – lateral view).

***Prosenia* Le Peletier, Serville, 1828.** No spermathecae have been described so far. The first-instar larvae were described by Richter and Farinets (1983).

The postabdomen tergites VI, VII are unparted, with a row of minute bristles along the back edge. The tergite VIII is unparted and without

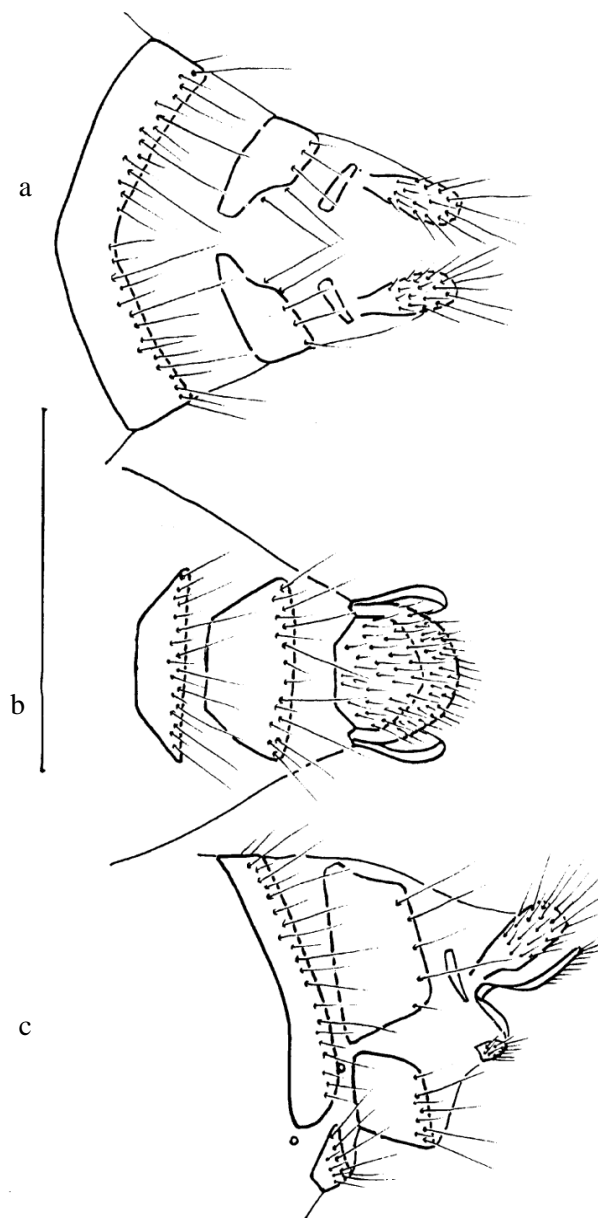


Fig. 8. Postabdomen of *Estheria cristata* Mg. (a – dorsal view, b – abdominal view, c – lateral view).

bristles. The final tergite is fully reduced. The sternite VI is widened towards the back edge, with bristles along it. The sternites VI, VII, VIII have two or three lateral bristles. The spiracles of the segments VI, VII are located on their respective tergites (Fig. 11).

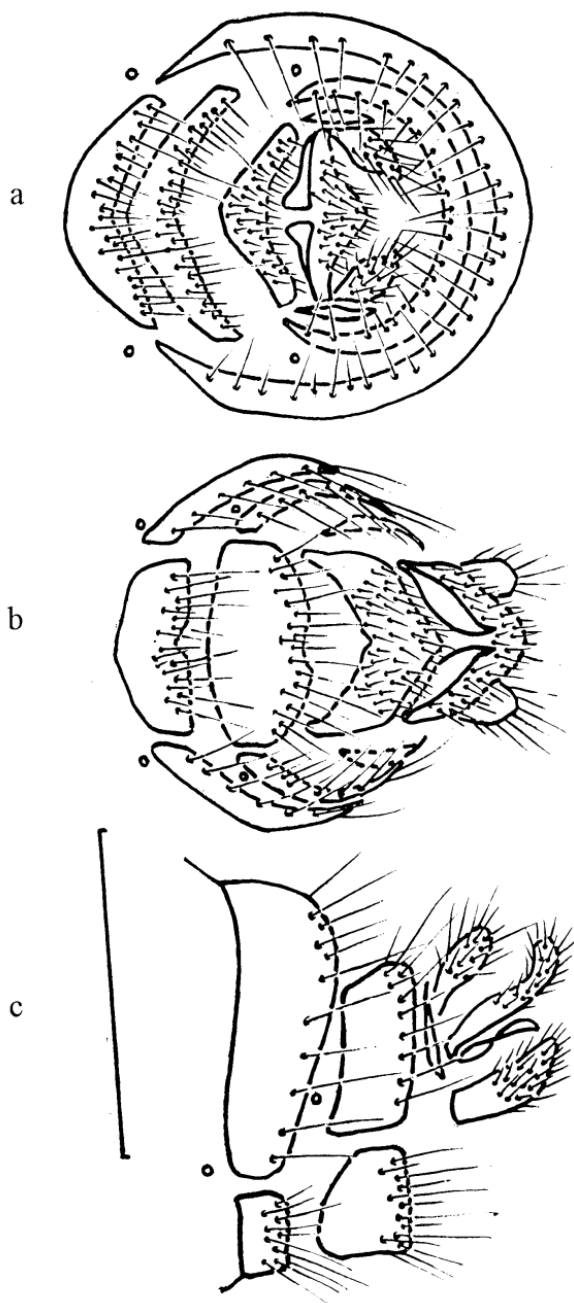


Fig. 9. Postabdomen of *Estheria petiolata* Bond. (a – dorsal view, b – abdominal view, c – lateral view).

***Zeuxia cinerea* Meigen, 1826.** No spermathecae have been described so far. The first-instar larvae were described by Richter and Farinets (1983).

The postabdomen tergites VI, VII are unparted, with a row of different-length bristles along the back edge. The tergite VIII is dorsally

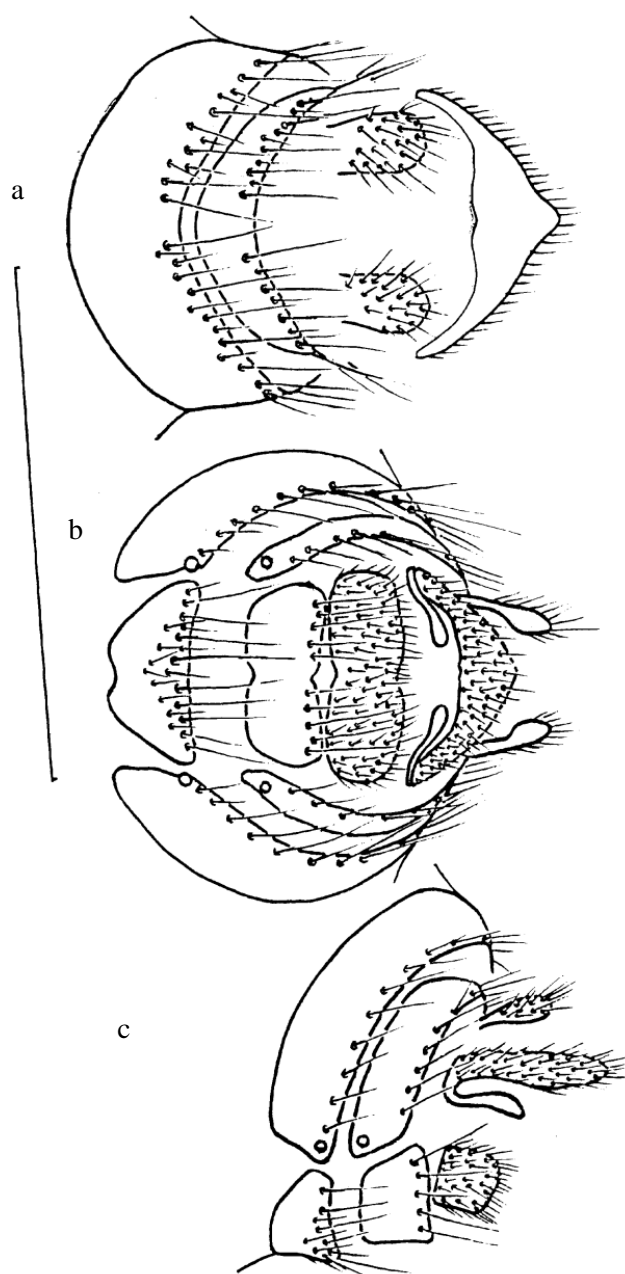


Fig. 10. Postabdomen of *Dexia rustica* F. (a – dorsal view, b – abdominal view, c – lateral view).

divided into two sclerites; their surface has no bristles. The final tergite is fully reduced. The sternite VI is the biggest one, it has bristles along its back part. The sternite VIII has bristles nearly along the entire surface. The spiracles of the segments VI, VII are located on their respective tergites (Fig. 11).

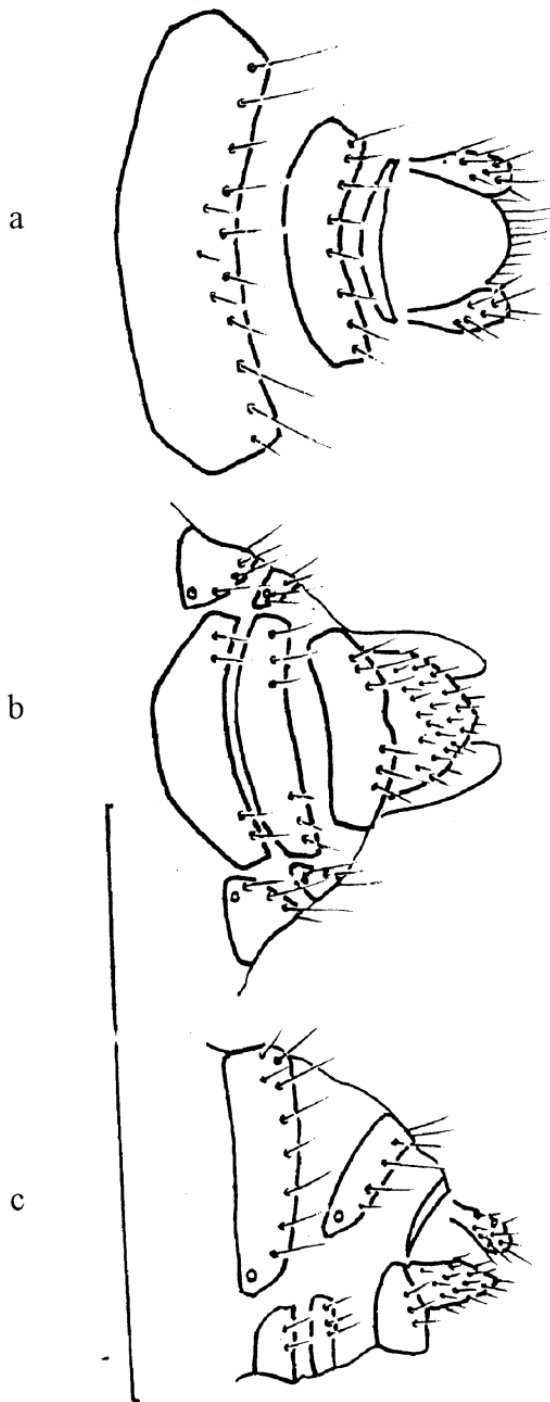


Fig. 11. Postabdomen of *Prosenia siberita* F. (a – dorsal view, b – abdominal view, c – lateral view).

Identification keys of Dexiini species by analysed postabdomen structure:

- 1(20) Tergite VII is unparted.
- 2(7) Spiracles are located on tergites of segments VI and VII.
- 3(4) Tergite VIII is unparted (Fig. 11) ***Prosenia siberita***

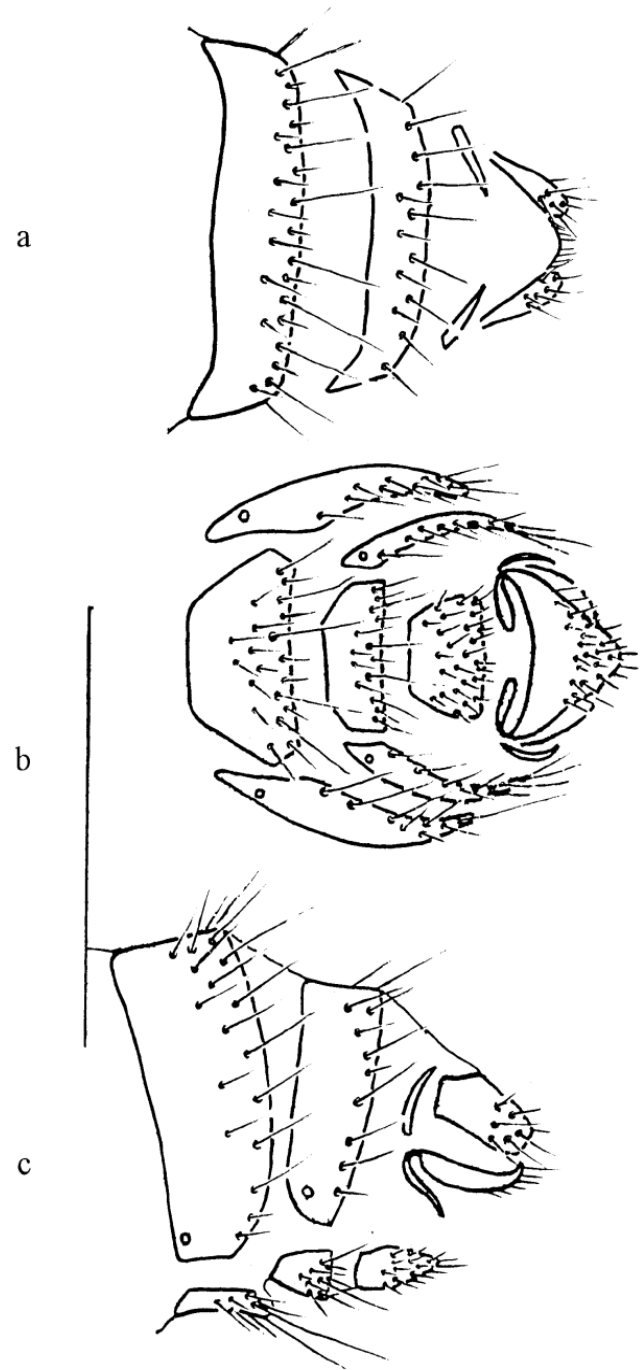


Fig. 12. Postabdomen of *Zeuxia cinerea* Mg. (a – dorsal view, b – abdominal view, c – lateral view).

- 4(3) Tergite VIII is fully reduced (Fig. 10) ***Dexia rustica***
- 5(6) Tergite VIII has another structure.
- 6(5) Tergite VIII is dorsally divided into two minute sclerites (Fig. 12) ***Zeuxia cinerea***
- 7(2) Spiracles on segments have other location.
- 8(15) Spiracles are located on membranes of segments.

- 9(12) Back edge of tergite VI has bristles up to the middle.
 10(11) Tergite VIII is unparted (Fig. 2) *Trixa caerulescens*
 11(10) Tergite VIII is fully reduced (Fig. 3) *Billaea adelpha*
 12(9) Back edge of tergite VI has one row of bristles.
 13(14) Sternite VII is wider than sternite VIII; laterally sternite VII has 3-4 bristles along the back edge (Fig. 5) *Dinera carinifrons*
 14(13) Sternites VII and VIII are equally wide; back edge of sternite VII has bristles (Fig. 9) *Estheria petiolata*

Discussion

Connection of all spermatheca ducts with the vagina with the help of one short channel (Fig. 1: A-G) is shown as a general trait of all analysed Dexiini species. The spermatheca ducts are somewhat longer or shorter than the spermatheca capsules. A similar phenomenon can be observed in some species of Voriini (genera *Eriothrix*, *Peteina*, *Thelaira*, *Stomina*) and Ernestiini (genera *Ernestia*, *Zophomyia*). In most Tachinidae, each of the three female spermathecae is connected with the vagina with a separate duct (Hori 1961; Farinets 2003; 2008). The connection of the spermathecae with the vagina observed in Dexiini, some Voriini and Ernestiini may be explained by evolutionary parallelisms, widely spread among the Tachinidae (Richter 1987).

The postabdomen of Dexiini females has a similar structure, viz.: tergite VI is unparted in all reviewed species; tergite VII is also unparted, except for *Estheria cristata*. In some Dexiini (*Prosenia siberita* (Fabricius, 1775), *Dinera grisescens*, *Trixa caerulescens* Meigen, 1824), tergite VIII is unparted, however in *Dinera*, *Estheria*, *Zeuxia*, tergite VIII is dorsally divided into two very minute sclerites, and it is fully reduced only in *Dexia* and *Billaea*.

- 15(8) Spiracles on segments have other location.
 16(19) Spiracles of segment VI are located on tergite VI; those of segment VII are located on the membrane.
 17(18) Tergite VI has bristles along the back part (Fig. 6) *Dinera ferina*
 18(17) Tergite VI has one row of bristles along the back edge (Fig. 7) *Dinera grisescens*
 19(16) Spiracles of segments VI and VII are located on tergite VI (Fig. 4) *Billaea pectinata*
 20(1) Tergite VII is dorsally divided into two sclerites with bristles along the back edge (Fig. 8) *Estheria cristata*

Alongside similar morphological changes of the postabdomen and spermathecae structures, Dexiini have proved to be similar in structure of their first-instar larvae (Richter, Farinets 1983).

Presence of oblong two-member hind sensory organs and clavately widened and ventrally bended front organs in the first-instar larvae is a peculiar trait for the Dexiini tribe. The reviewed first-instar larvae had one pair of short or long lateral bristles on each segment. The surface of the body of the larvae is covered with differently-shaped plates, except for *Trixa* (Richter, Farinets 1983). The development of the cuticular plates in tribe representatives may have been connected with the switch of the planidium-shaped larvae to active pursuit of a host; these plates remaining in external environment for a certain period of time and performing the protective function. Among the tachina flies, a similar phenomenon may be seen in some Tachininae.

Upon studying of the morphology of certain traits of the postabdomen, spermathecae, and first-instar larvae of Dexiini, we tried to systematise the reviewed species with the help of clusterisation of the obtained data (Fig. 13-15).

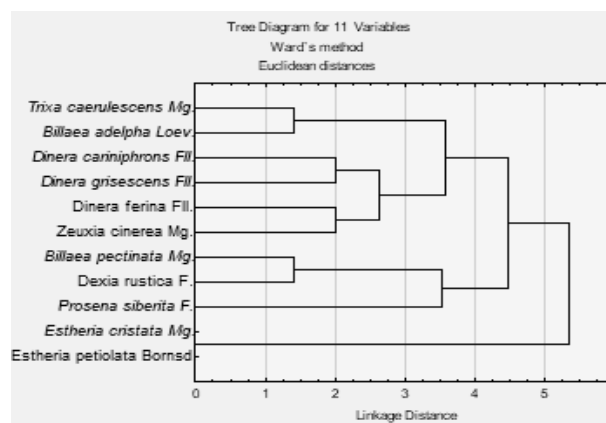


Fig. 13. Kinship of Dexiini based on the analysis of the morphology of 18 traits of the postabdomen.

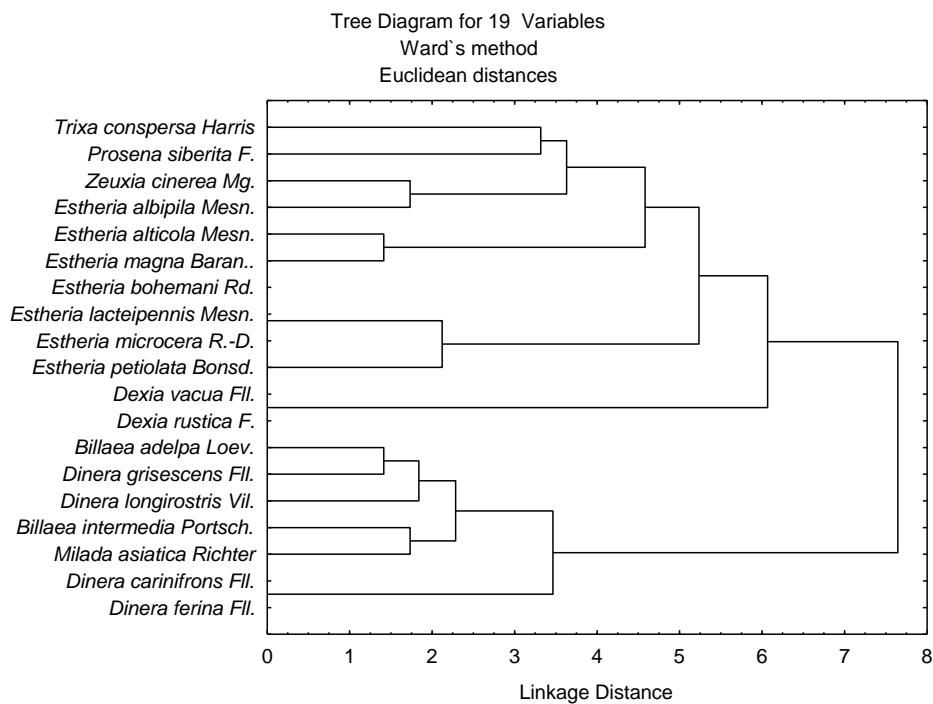


Fig. 14. Kinship of first-instar larvae based on the analysis of the morphology of 25 traits.

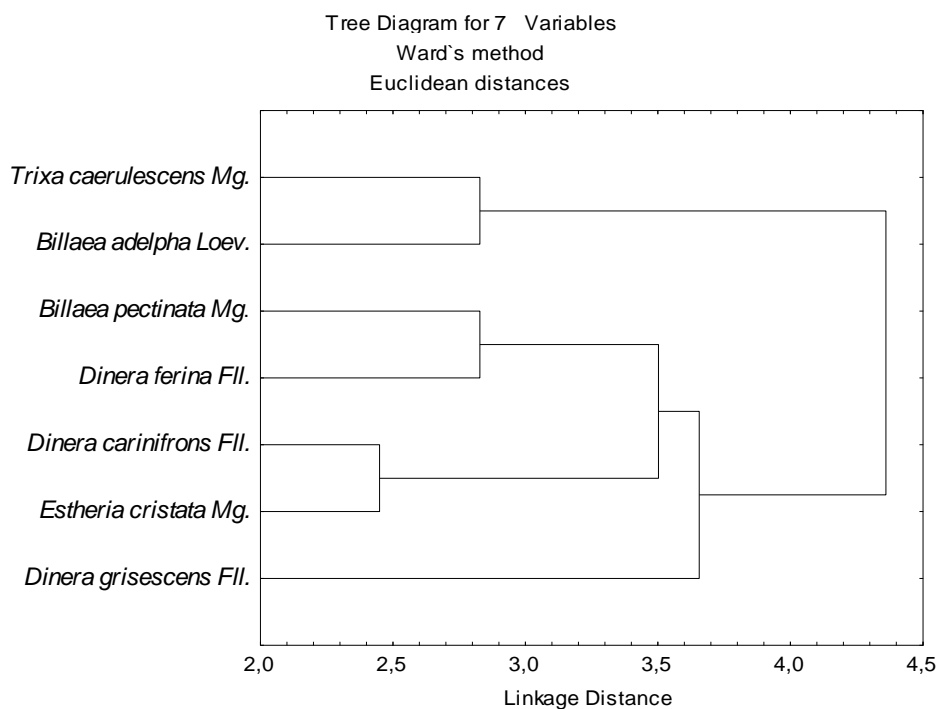


Fig. 15. Kinship of Dexiini based on the analysis of the morphology of 28 traits of postabdomen and spermathecae.

When analysing the trait combinations of these structures, certain species showed weak intragroup connections and thus were classified into different clusters. However, the analysis of the morphology of 25 traits of the first-instar larvae proved that *Estheria* genus demonstrated clear kinship of many species (Fig. 14). On the contrary,

Billaea adelpha other species were exposed to considerable changes, depending upon the use and analysis of the traits of the first-instar larvae, spermathecae and postabdomen – they may line up in a cluster with this or that species. This fact may need further investigation.

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