

Key to the Central American and Caribbean species of the *Frankliniella minuta* group (Thysanoptera: Thripidae) with the description of a new species

AXEL P. RETANA-SALAZAR^{1*}, OCTAVIO JHONATHAN CAMBERO-CAMPOS², ALCIDES SÁNCHEZ-MONGE¹ & J. ALEXANDER RODRÍGUEZ-ARRIETA¹

¹Programa Universitario de biología Aplicada (PUA), Centro de Investigación en Estructuras Microscópicas (CIEMic), Ciudad de la Investigación, Universidad de Costa Rica, 2060. San José, Costa Rica.

²Departamento de Parasitología, Universidad Autónoma Agraria Antonio Narro, C.P. 25315, Buenavista, Coahuila, México.

RESUMEN: El grupo *Frankliniella minuta* es un complejo de especies con reducción de las setas de la cabeza y el pronoto. En este trabajo se describe una nueva especie de *Frankliniella* sin sensilas campaniformes en el metanoto, como en *minuta*, pero con pelos interocelares muy reducidos como en *marinae* y setas anteromarginales menores muy reducidas. Las comparaciones con otras especies del grupo en la colección de trips de Costa Rica apoya esta posición taxonómica.

PALABRAS CLAVE: *Frankliniella minuta* group, new species, Costa Rica.

ABSTRACT: *Frankliniella minuta* group is a complex of species with reduction of the setae of the head and the pronotum. In this paper we describe a new species of *Frankliniella* without campaniform sensillae in the metanotum as in *minuta*, but with much reduced interocellar setae as in *marinae* and very reduced minor anteromarginal setae. Comparisons with other species of the group in the thrips collection from Costa Rica support this taxonomic decision.

KEY WORDS: *Frankliniella minuta* group, new species, Costa Rica.

INTRODUCTION

The genus *Frankliniella* Karny 1910 is one of the most complex genera of Thripidae. Mound and Marullo (1996) suggested that this genus included about 180 species, Mound and collaborators (2005) considered 160 species and Bhatti (2006) proposed that this genus is comprised of more than 200 species. Despite the diversity of this genus, this taxon is homogeneous in range of body form (Mound and Marullo 1996). Jacot-Guillarmod (1974) listed the species of this genus and established that 90% of them were from the Neotropics. *Frankliniella* is mainly neotropical, there are 44 species reported for Central America (Mound and Marullo 1996) but there are seven species considered as endemic to the Old World

(Nakahara 1997). These species are: *F. intonsa*, *F. pallida*, *F. tristis*, *F. dulmaae*, *F. lilvora*, *F. zizaniophyla* and *F. antarctica*.

The species *F. occidentalis*, *F. schultzei* and *F. williamsi*, are widely distributed and each of these is considered to be New World in origin (Mound *et al.* 2005). In this paper, we present the description of a new species of the *Frankliniella minuta* group recently collected in Costa Rica and a key to the species of the *minuta* group from Central America and the Caribbean.

Autor

Correspondencia: axel.retana@ucr.ac.cr*

The *Frankliniella minuta* group

Hood (1925) outlined the concept for the species groups including the *minuta* group, and specified the dilation of the pedicel of antennal segments III as a characteristic of the *tritici* group. Hood (1925) proposed four species groups in *Frankliniella*: *tritici*, *cephalica*, *intonsa* and *minuta*, and he defined the *minuta* group by having the ocellar setae shorter than the diameter of the ocelli. Moulton (1933, 1948) combined the *tritici* and *cephalica* groups and subdivided the *intonsa* group. Moulton (1948) gave an arbitrary limit up to 28 μm for the length of the interocellar setae, and he indicated that the posocular and the anterior pronotal setae are also reduced, and that the antenna is compact. Members of the *minuta* group usually can be separated from those of other groups by having both principal postocular and interocellar setae of less than 20 μm in length and the anterior pronotal setae less than 30 μm long. However, Sakimura and O'Neill (1979) proposed that this is not a good criterion for the species of the *minuta* group segregation because the division is arbitrary and large individuals (especially of *minuta* itself) will exceed these limits, and small individuals of other groups may fall within them. The smaller species of the *intonsa* group are difficult to segregate from species of the *minuta* group, to which Moulton (1948) assigned 11 species.

The unsatisfactory nature of the boundaries for this group was reviewed by Retana-Salazar and Mound (1994), who proposed the segregation of the *minuta* group by using the ratio between the length of the ocellar setae III and the anteroposterior length of the posterior ocelli. They established that the *minuta* species group have a ratio where ocellar setae III was less than 2 times as long as anteroposterior length of the posterior ocelli. However, some species with little interocellar setae have a ratio of more than 2.3 times between the ocellar setae length and the anteroposterior diameter of the posterior

ocelli. In these cases the problem is the reduction of the ocelli, which may be a response to some environmental conditions. All these unsuccessful attempts to resolve the limits of this group of species lead to look for natural characters that can define the *minuta* group. With phylogenetic analysis, Retana-Salazar (1998b) showed that this group is a natural unit but this kind of analysis needs to include some particular species traditionally included in other groups such as in *bagnalliana*, otherwise the *minuta* group is a paraphyletic group of species.

Four species of the *Frankliniella minuta* group were mistakenly assigned to *Isochaetothrips*, these species were reviewed by Sakimura and O'Neill (1979). However, some species included in the *minuta* group by Sakimura and O'Neill (1979) are not congruent with all the characters that define the genus *Frankliniella* as defined by Retana-Salazar (1998a). In these cases more studies are necessary to establish the real taxonomic position of these species as well as morphological characters that are really important in the phylogenetic structure of the group, in order to define the boundaries of segregation of the different groups of species and to obtain an objective perspective of the evolutionary process.

In Central America and the Caribbean region Mound and Marullo (1996) have recorded 15 or 16 species that belong to the *minuta* group. After this, at least three new species in the *minuta* group have been published, *marinae* and *moundi* by Retana-Salazar (1998a) and *senckenbergiana* by Berzosa & Maroto (2003) which was segregated based on the colour pattern of the terminal segments of the antennae. Retana-Salazar (2010) showed that some patterns of colour may be important in phylogeny and also in taxonomic descriptions, however more detailed studies are needed before the segregation of new species based only on colour.

The species of the *Frankliniella minuta* group are listed below and a key to all the species is given. In this paper we also describe a new species similar to *F. curta* in several characters and to other species closely related to *F. minuta*. This species is very particular and it was collected in Costa Rica recently.

MATERIAL AND METHODS

Material was collected in Costa Rica in several localities by swapping in flowers, and in Nayarit, México in weeds associated to avocado crops. The specimens were kept in 70% alcohol and mounted in Canadian balsam with the protocol described by Kobro (2003). The material was examined with a light microscope, Olympus IX 50 and the software Olympus DP Controller for microscopic image capture.

Abbreviations in text

BMNH: British Museum of Natural History, London, England, UK.

CEUNA: Colección Entomológica de la Universidad Nacional de Costa Rica, Heredia, Costa Rica.

CIEMic: Centro de Investigación en Estructuras Microscópicas, Universidad de Costa Rica.

IBUNAM: Instituto de Biología de la Universidad Nacional Autónoma de México, México DF, México.

INBio: Instituto Nacional de Biodiversidad, Heredia, Costa Rica.

MIUCR: Museo de Insectos de la Universidad de Costa Rica.

NHMB: Natural History Museum of Bergen, Bergen, Norway.

SMF: Senckenberg Museum, Frankfurt, Germany.

KEY TO CENTRAL AMERICAN AND CARIBBEAN SPECIES OF *Frankliniella minuta* GROUP (modified from Mound & Marullo 1996)

1a) Ocellar setae III very reduced no more than 5-8 microns length _____ 2

1b) Ocellar setae III less than 2 times the longitudinal diameter of the hind ocelli; always more than 10 microns length _____ 5

2a) Metanotum without campaniform sensillae _____ *microchaeta* sp.n.

2b) Metanotum with campaniform sensillae ___ 3

3a) Anteromarginal minor setae and anteromarginal major setae with same length; ocellar setae III close together within ocellar triangle _____ *curta*

3b) Anteromarginal minor setae reduced and anteromarginal major setae well developed; ocellar setae III in different position _____ 4

4a) Pronotum with a strong ornamentation with widely separated striations, these lines of sculpture appear as grooves; dark brown species _____ *moundi*

4b) Pronotum with normal ornamentation of striations; pale species _____ *marinae*

5a) Antennal segment III pedicel with well developed ring or at least an evident swelling _____ 6

5b) Antennal segment III pedicel simple _____ 7

6a) Tergite VIII without a posteromarginal comb medially _____ *breviseta*

6b) Tergite VIII with a posteromarginal comb well developed; segment II enlarged and with two large dorsal setae _____ *diversa*

7a) Head at least 0.8 times as long as wide _____ *mekokara*

7b) Head less than 0.7 times as long as wide ___ 8

8a) Pronotal anteromarginal setae scarcely differentiated from anteromarginal minor setae; ocellar setae III close together into the ocellar triangle; position 3/4; antennae slender; III more than two times as long as wide; abdomen without brown cuticular pigment _____ *aureominuta*

8b) Pronotal anteromarginal setae clearly longer than minor setae; ocellar setae III variable in position _____ 9

9a) Antennal segment II sharply constricted to base; maximum diameter two times the minimum diameter _____ *kiesteri*

9b) Antennal segment II not much narrower at base than apex _____ 10

10a) Ocellar setae III arising outside ocellar triangle _____ 11

10b) Ocellar setae III arising in position 2 or within the ocellar triangle _____ 12

11a) Metanotum without campaniform sensillae; tergite IX setae B1 shorter than B2 (94-115, 230-280) _____ *minuta*

11b) Metanotum with campaniform sensillae; tergite IX setae B1 and B2 subequal in length _____ *hansoni*

12a) Tergite IX setae B1 of female shorter than median length of tergite X _____ 13

12a) Tergite IX setae B1 of female equal to or longer than median length of tergite X _____ 15

13a) Pronotal anteromarginal setae 15-25 microns long, scarcely twice as long as discal setae; postocular setae I absent; antennal segment III brown or yellow brown; male brown _____ *colombiana*

13b) Pronotal anteromarginal setae more than 30 microns long; three times as long as discal setae; postocular setae I present or absent; antennal segment III commonly yellow _____ 14

14a) Pronotum with median discal setae 5-7 microns long; postocular setae I absent; male dark brown similar in colour to female _____ *montanosa*

14b) Pronotum with median discal setae 12-17 microns long; postocular setae I present; male yellow _____ *bagnalliana*

15a) Body colour yellow; without or with only very pale grayish markings _____ *distinguenda*

15b) Body colour brown, or if yellowish then with brown markings on thorax and abdomen _____ 16

16a) Pronotal anteroangular setae more than 35 microns long _____ 17

16b) Pronotal anteroangular setae less than 30 microns long _____ 19

17a) Head with postocular setae I absent; tergite IX setae B1 65 microns long; pronotal anteroangular setae 37 microns long _____ *floydandrei*

17b) Head with postocular setae I present _____ 18

18a) Antennal segments V-VI dark brown, tergite IX setae B1 more than 80 microns long; pronotal anteroangular setae more than 48 microns long _____ *vargasi*

18b) Antennal segments V-VI pale, tergite IX setae B1 100 microns long, pronotal anteroangular setae 60-61 microns long _____ *senckenbergiana*

19a) Body colour dark brown including femora, mid and hind tibiae yellow; antennal segments I-II brown; III-IV mainly yellow _____ *cotobrusensis*

19b) Body colour yellow with grayish brown shadings; mid and hind legs not sharply bicoloured; antennal segment I yellow; II-VIII mainly light brown _____ *zurqui*

Frankliniella microchaeta sp.n.

MATERIAL. Holotype. ♀ macroptera, Costa Rica, Alajuela, in flowers, 12-XI-2007. Deposited at the MIUCR. Paratypes 18: 2 ♀♀ with the same data as holotype. Other paratypes 1♀, Costa Rica, Heredia, Sarapiquí, Puerto Viejo, Estación Biológica La Selva, in *Columnea* sp. (Gesneriaceae) flowers 17-XI-1991 (ARS51191). 6 ♀♀, Costa Rica, San José,

Ciudad Colón, Finca El Rodeo, in *Calea* sp. (Asteraceae) flowers 19-XI-1991 (ARS101191). 6 ♀♀, Costa Rica, Alajuela, Volcán Poás, in *Senecio* sp. (Asteraceae) flowers II-1991 (ARS45). 1 ♀, Costa Rica, Alajuela, Volcán Poás, in *Eupatorium* sp. (Asteraceae) flowers II-1991. 4 ♀♀, Nayarit, México, Avocado (*Persea americana*, Lauraceae) crop, collected in weeds, J. Cambero-Campos. Deposited in BMNH, CEUNA, CIEMic, IBUNAM, INBio, MIUCR, NHMB, SMF.

Body and legs dark brown (Fig. 1A). Antennal segment III shaded. Wings shaded. First vein with 18 setae. Head ornamentation absent in first two thirds, posterior third with strong and widely separated striations. Ocellar setae reduced, pair I and II with no more than 3 microns. Pair III with no more than 7.5 (5-7.5) microns length (Fig. 1B). Eyes with four ventral, dark coloured ommatidia. Pronotum without ornamentation and several discal setae. Probasisternum divided (Fig. 1C). Prospinasternum with irregular margin, lanceolate and broad apex. Anteroangular and anteromarginal setae reduced. Mesonotum with striations widely separated and without discal setae. Metanotum laterally striated and with weakly central ornamentation (Fig. 1D). With two pairs of metanotal setae on the anterior margin. Metanotum without campaniform sensillae (Fig. 1D). Abdominal tergites without ornamentation or only weakly lateral striations. Ctenidia present in segments IV-VIII. Posterior margin of abdominal tergum VIII with a well developed comb of microtrichia (Fig. 1E). Bases close together and particularly close in the central section of the comb. Male unknown.

Measures of the holotype (microns): Head setae oI 3.0 (2.5-3.0); oII 3.0 (2.5-3.0), oIII 5.0 (5.0-7.5), poI 2.5, poII 2.5, poIII 7.5, poIV 2.5. Pronotal setae aa 12.5, amM 15, pa 35, pmI 7.5, pmII 25. Antennal segments length I 22.5, II 27.5, III 35 (pedicel 7.5), IV 35, V 27.5, VI 37.5

VII 7.5, VIII 12.5. Wing length 600. Total length 1600.

COMMENTARY. This species is similar to *F. minuta* in the colour and in the absence of metanotal campaniform sensillae. The reduction of ocellar setae is a prominent difference, particularly in ioIII where in *F. minuta* there are from 12 to 31 μm long (Sakimura and O'Neill 1979), (Table 1). Specimens collected in Costa Rica frequently have these same proportions. *F. curta*, *F. marinae* and *F. moundi* show the same reduction of the interocellar setae. All these species have metanotal sensillae, *F. curta* has the anteromarginal minor and major setae of a similar length. *F. marinae* has well developed anteroangular setae and *F. moundi* has a particularly strong ornamentation in the pronotum. All these characters suggest that this material is a new species. Few species in *Frankliniella* lack the metanotal sensillae, in Costa Rica the only species without this character within the *minuta* group is the species *minuta*. The extreme reduction of the ioIII is present in *marinae*, *moundi* and *curta* and this character may be convergent. This species has a divided probasisternum, a feature that is uncommon in this genus. The prospinasternum of these species has been well studied, it is rectangular with apex in right angle and with regular margins in *curta*, *moundi* and *marinae*, but it is lanceolate in apex and with irregular margins in this new species. Mound and Marullo (1996) considered that the species *minuta* has a particular development of the setae B1 and B2 in tergite IX where B1 is shorter than B2 (94-115, 230-280). In these species this tendency is the opposite except in the species *marinae* (Table 1). Regarding the importance of measures in species segregations, Minaei and Mound (2010) published an interesting paper where they evaluate the problem of measures in microscopic preparations. These authors considered five numbered points about measurements, but according to them, the most important is number 3; the human error. Minaei

and Mound (2010) present good evidence in some particular groups of insects such as thrips, aphids and parasitic hymenoptera that shows that it is essential that the records of each measurement are kept by someone else other than the person who is doing the measuring, otherwise, it is just a simply reproduction without this control. Measuring photographs or images, reduces the variance, but does not increase the accuracy because only one focal plane is involved. Higher magnification implies greater variance, and that is why in most recent papers L. Mound rounds up (or down) many measurements to the nearest 5 microns, this achieves results that are close to being consistent. However, if measures are not definitory in segregations, these are good parameters for biological variations, and in this case several other qualitative characters justify the segregation.

ACKNOWLEDGMENTS

We appreciate the collaboration of Sverre Kobro from Bioforsk, who collected some of the material for this description. We also thank Richard Meadow and Ricardo Holgado for valuable comments and corrections to the draft of this manuscript. We appreciate the comments of Laurence Mound about the first manuscript and the literature that he facilitated.

REFERENCES

- Berzosa J, Maroto J. 2003.** New Neotropical species of the genus *Frankliniella* Karny (Insecta: Thysanoptera: Thripidae). *Studies on Neotropical Fauna and Environment* 38(2): 135-144.
- Bhatti JS. 2006.** The classification of Terebrantia (Insecta) into families. *Oriental Insects* 40: 339-375.
- Hood JD. 1925.** New species of *Frankliniella* (Thysanoptera). *Bull. Broocklym Entomol. Soc.* 20-2.
- Jacot-Guillarmod CF. 1974.** Catalogue of the Thysanoptera of the World. *Ann. Cape Prov. Mus. (Nat. Hist.)* 7: 517-976.
- Kobro S. 2003.** On the Norwegian thrips fauna (Thysanoptera). *Norw. J. Entomol.* 50: 17-32.
- Minaei K, Mound LA. 2010.** Taxonomic problems in character state interpretation: variation in the wheat thrips *Haplothrips tritici* (Kurdjumov) (Thysanoptera, Phlaeothripidae) in Iran. *Dtsch. Entomol. Z.* 57(2): 233-241.
- Moulton D. 1933.** The Thysanoptera of South America II. Rio de Janeiro-Brasil. *Rev. Entomol.* 3: 96-133.
- Moulton D. 1948.** The genus *Frankliniella* Karny, with keys for the determination of species (Thysanoptera). *Rev. Entomol. U.S. Dept. Agr.* 19:55-113.
- Mound LA, Marullo R. 1996.** Thrips of Central and South America. *Memoirs on Entomology.* 458 pp.
- Mound LA, Nakahara S, Day MD. 2005.** *Frankliniella lantanae* sp. n. (Thysanoptera: Thripidae), a polymorphic alien thrips damaging *Lantana* leaves in Australia. *Australian J. of Entomol.* 44: 279-283.
- Nakahara S. 1997.** Annotated list of the *Frankliniella* species of the World (Thysanoptera: Thripidae). *Contribution on Entomology, International. Associated Publishers, Gainesville, Fl, USA.* 2(4): 354-389.
- Sakimura K, O'Neill K. 1979.** *Frankliniella* redefinition genus and revision of the minuta group species (Thysanoptera: Thripidae). *U.S. Dept. of Agr. Tech. Bull.* 1572: 1-49.
- Retana-Salazar AP. 1998a.** Reestablecimiento de los géneros *Frankliniella*, *Exophthalmothrips* y *Bolbothrips* (Thysanoptera: Thripidae). *Rev. Biol. Trop.* 46(2): 385-396.
- Retana-Salazar AP. 1998b.** Una visión filogenética de *Frankliniella* (Thysanoptera: Thripidae). *Rev. Biol. Trop.* 46(2): 397-406.
- Retana-Salazar AP. 2010.** El grupo genérico *Frankliniella*: el significado filogenético de sus

principales caracteres morfológicos (Thysanoptera: Thripidae, Thripini). Métodos en Ecología y Sistemática (in press).

Retana-Salazar AP, Mound LA. 1994. Thrips of the *Frankliniella minuta* group (Insecta: Thysanoptera) in Costa Rican Asteraceae flowers. Rev. Biol. Trop. 42:639-648.

Recibido: 13 Marzo, 2010.
Aceptado: 1 Junio, 2010.

Table 1. Comparative structures and measures (in microns) of the species of *Frankliniella* with reduced interocellar setae.

Charater/species	<i>curta</i>	<i>marinae</i>	<i>moundi</i>	<i>microchaeta</i> sp.n.
Seta B1	52,5	55	62,5	30
Seta B2	52,5	55	72,5	77,5
Prospinasternum shape	rectangular, extremes abruptly right, regular margins, wide and long and without ornamentation	rectangular, extremes abruptly right, regular margins, wide and long and without ornamentation	rectangular, extremes abruptly right, regular margins, wide and long and without ornamentation	lanceolate, extremes gradually reduced, irregular margins, wide and long and without ornamentation
Probasisternum	complete, slightly thin at middle	complete, slightly thin at middle	complete, slightly thin at middle	divided
Distribution	Trinidad, Brazil, Peru Colombia, Costa Rica	Costa Rica	Costa Rica	Costa Rica

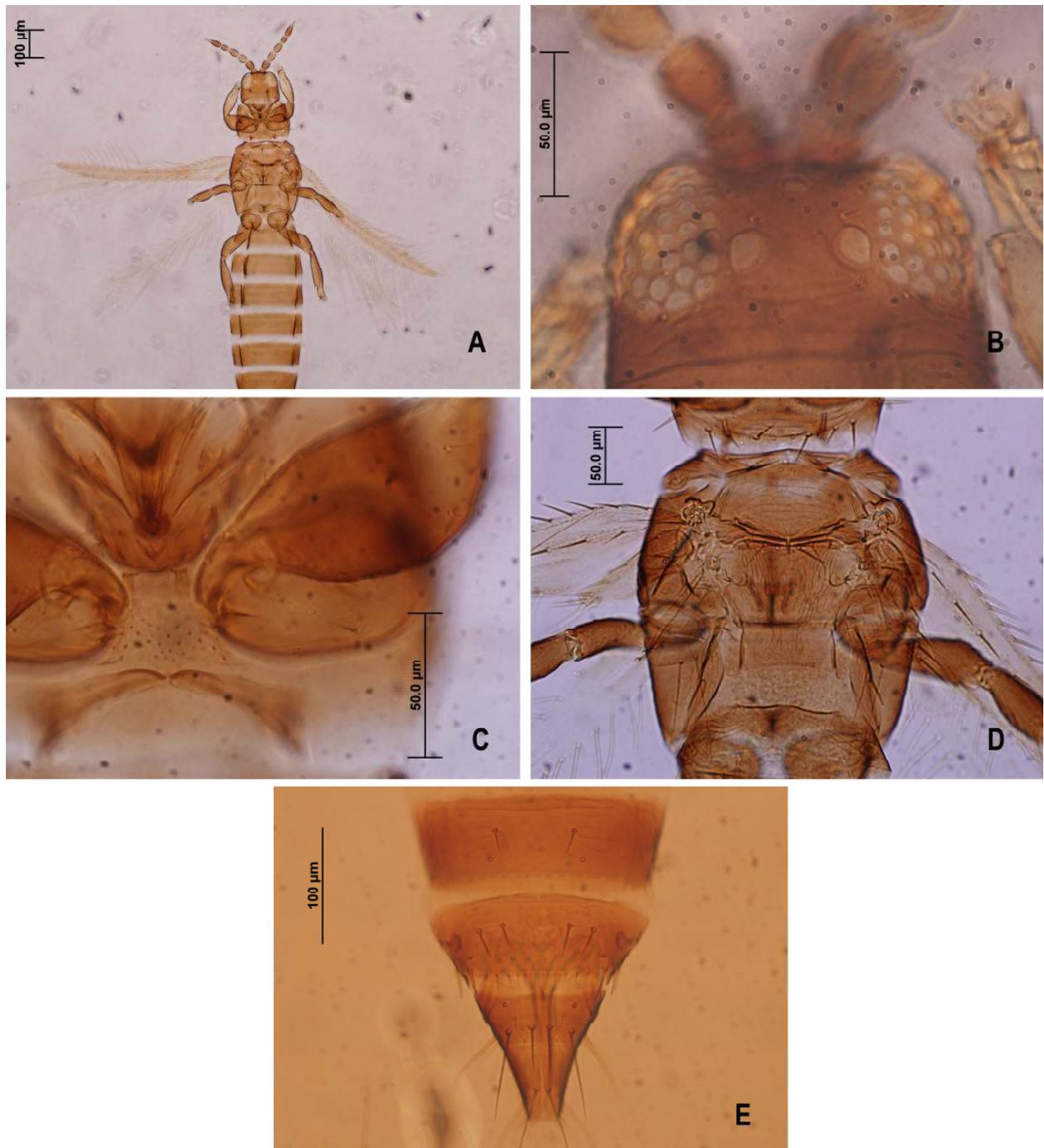


Figure 1. *Frankliniella microchaeta* holotype, general view (A), intercellular setae (B), probasisternum (C), pterothorax (D), abdominal terga VII-X (E).