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Thrips of the *Frankliniella minuta* group (Insecta: Thysanoptera) in Costa Rican Asteraceae flowers

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Abstract: Six new species of the genus *Frankliniella minuta* group are described, all from Costa Rican Asteraceae, and mainly from high altitudes: *Frankliniella kiesteri, Fr. hansoni, Fr. vargasi, Fr. cotobrusensis, Fr. zurqui* and *Fr. montanosa.* A diagnosis of the genus is given and the *minuta* group is redefined; according to the new definition *Frankliniella diversa* and *Frankliniella bagnalliana* are included in this species group. A key to eleven species for 11 species is presented.

Key words: Thrips, *Frankliniella minuta* group, new species, Costa Rica, Asteraceae.

The order Thysanoptera has received little attention in Costa Rica, possibly because it normally is a secondary pest in crops of low economic value. Mound & Retana (1994) provide an identification key to more than 40 genera of the family Thripidae known from Costa Rica. However, almost half of the known species in this family belong to one genus, *Frankliniella.* If some understanding is to be developed of the biology of Thysanoptera in Central America, accurate recognition of species in this large but homogeneous genus is essential for future studies.

Species of *Frankliniella* are common in flowers of many taxa throughout the New World (especially the Neotropics). Unfortunately, very little is known about the biology of most of these species; a few seem to be polyphagous and many appear to be oligophagous, but accurate information on host specificity is difficult to obtain. Thrips are highly vagile, and stray individuals alight on a wide range of plants. Thus it is not possible to deduce true host relationships without repetitive collecting over an extended period of time, leading to recognition of the larval host plants. The objective of this paper is to make possible the recognition of the most common species of one species-group of *Frankliniella* in Costa Rica, in order to provide the basis for future studies on their host ranges and biologies.

Previous studies on Frankliniella: Worldwide, *Frankliniella* includes 253 species (at least 88 are synonyms). With 4% of species, this is the largest genus. It was described in 1910 by Karny, for the European species *Thrips intonsa* Trybom. Nevertheless, very few other members of this genus come from the Old World. Unfortunately the standard of taxonomic work on this genus, at times, has been unsatisfactory. For example, Moulton described 65 species of *Frankliniella* between 1907 and 1948, but 30 of these are already placed in synonymy, and this proportion is expected to increase further. Similarly, Priesner described 27 species of which 17 are now regarded as synonyms. Unfortunately these,

and several other authors, failed to realize that many species of *Frankliniella* vary in size and colour (depending on maturity and possibly on food source or temperature of development). In contrast, Hood described 52 species for the genus between 1912 and 1955, and only two of these have been placed as synonyms.

Moulton (1948), after describing some of its species made the only global review of the genus. He prepared identification keys to species and grouped these in subgenera, some of which are ambiguous. Unfortunately, the key was rendered useless for its invalid geographic criteria.

Sakimura and O'Neill (1979) reviewed the *minuta* group and added descriptions of new species and a wider, comprehensive redefinition of the genus. Sakimura (1986) studied some Jamaican thrips and Johansen described some species for Mexico (1977, 1979, 1989), giving keys and including in part *Frankliniella.* This relatively recent paper is one of the few on the Neotropics. Finally, Mound & Nakahara (1994) summarized the morphological characters which can be used to define this genus, and reviewed many of the problems of species recognition due to colour and structural variation which have not been adequately considered by some previous authors.

Problems with species recognition: The preparation procedure can affect morphology. For example, Hoyer's medium creates undulating setae. The macerating substance affects coloration and the clarity with which features are seen. Excess pressure on the cover slide stretches the animal, producing for example wider abdomens and head bases, together with longer bucal parts and displaced and longer setae. Attention must be paid to the fact that morphological variation within a species can be greater than variation among several species. For example, *Frankliniella occidentalis* Pergande resembles *Frankliniella intonsa* (Trybom) although both have a great variability of color and shape. They can be distinguished by the length of the postocular setae, a character of little importance in other taxa in which this character varies greatly (Palmer et al. 1989). Similarly, *Fr. occidentalis* is remarkably variable in colour, not just due to progressive darkening with age and maturity, but also due to the existence of genetically controlled colour variants (Bryan & Smith 1956).

Sexual dimorphism is important in *Frankliniella:* males are smaller. Sometimes females are similar to each other in colour while the males are either pale or dark. Similarly, in some species large males have very stout setae at the apex of the abdomen, whereas small males have short slender setae. Again, such differences can only be recognized through repetitive collecting.

MATERIAL AND METHODS

The following localities of the Central Plateau (Meseta Central) of Costa Rica were sampled: San Jose: Universidad de Costa Rica, San Pedro de Montes de Oca; Sabanilla, San Pedro de Montes de Oca; Ciudad Colón, Finca El Rodeo; San Sebastián; Guadalupe; San Miguel de Escazú; San Antonio de Escazú; Villa Mills; Cerro de la Muerte. Cartago: Volcán Irazú; Ochomogo; Coris; Taras; Flores Garcia. Alajuela: Volcán Poás; Autopista Bernardo Soto, road to Atenas. Heredia: Zurquí, Braulio Carrillo; Estación Biológica La Selva, Sarapiquí.

In other areas these sites were: Limón: Horquetas, Guápiles. Puntarenas: Agua Buena, Península de Osa; Puerto Escondido, Península de Osa; Rancho Quemado, Península de Osa; Monteverde. Guanacaste: Estación Pitilla; 26 millas de Santa Elena, road to Las Juntas; Playa Naranjo; Santa Rosa.

Specimens were collected in AGA or in flowers in 60 % alcohol and mounted into Canada Balsam according to Palmer *et al.* (1989).

The Insect Museum of the Universidad de Costa Rica houses a reference collection with some 1200 thrips specimens mounting in Canada Balsam, treated with NaOH (5%) as permanent reference.

Text conventions:

MIUCR: Museo de Insectos, Universidad de Costa Rica.
USNM: United States Natural History Museum, Washington, D.C.
BMNH: The Natural History Museum, London.
SMF: Senckenberg Museum, Frankfurt.

FRANKLINIELLA KARNY

Frankliniella Karny, 1910: 46. Type-species *Thrips intonsa* Trybom.

Diagnosis: Head with 3 pairs of ocellar setae, also a series of small postocular setae of which seta IV is the longest (seta I is absent in some species); antennae 8-segmented (rarely 7-segmented), with forked sense cones on III & IV. Pronotum with 1 pair of long anteromarginal and anteroangular setae (aa & am setae reduced in members of *minuta*-group), also 2 pairs of long posteroangular setae; posterior margin of pronotum with 8 pairs of setae, including 1 pair of small median setae (B1). Metanotum with both pairs of setae arising at the anterior margin. Forewing with a complete row of setae on both longitudinal veins. Abdominal tergite II with 3 pairs of lateral marginal setae; tergite VIII usually with a posteromarginal comb of microtrichia; tergites V-VIII with a pair of oblique rows of microtrichia laterally (ctenidia), on VIII these ctenidia are anterolateral to the spiracles. Sternites without any discal setae; sternite VII with all three pairs of setae arising at the posterior margin

Comments: The position of ocellar setae pair III is very useful in recognizing species (fig. 5). Position 1 is anterolateral to the ocellar triangle; position 2 is between the anterior and posterior ocelli; position 3 is within the inner ocellar triangle; position 4 is between the posterior ocelli. Position 2 is the most common.

Frankliniella usually has four pigmented facets (five in *Fr. schultzei*), a character apparently lacking in few species. The immatures have reduced microtrichia on the third antennal segment; with a row of small teeth in the posterior margin of tergite IX, distance between the pair of nearest dorsal sensillae twice the distance between the median dorsal setae, sclerotized posterior band usually reaches in its fore part beyond the dorsal setae; in tergite X this band reaches at least the dorsal sensilla (Mound & Nakahara 1994 in press).

Mound & Palmer (1992) list 17 species of *Frankliniella* from Panama, but about 50 members of this genus have now been collected in Costa Rica, although many are either undescribed or unidentified. This report, a detailed account of the 11 species of the minuta-group which have been found in Costa Rica is part of a thesis presented for an M.Sc. degree at the University of Costa Rica by the senior author. This included preliminary identification keys to 30 species of this genus.

The Frankliniella minuta species-group: Sakimura & O'Neill (1979) have given an account of this group. During the course of the present studies it became clear that the group is probably a polyphyletic assemblage of species in which the major setae on the head, and sometimes the pronotum, are reduced in length. Species closely related to *Fr. minuta* have ocellar setae III widely separated on the anterior margins of the ocellar triangle. In contrast, most of the species included in the minuta-group have these setae close together within the ocellar triangle, often close to the inner anterior margins of the posterior ocelli (position 2/3/4). Functionally the group is defined as including those species in which ocellar setae III are less than 2.0 times as long as the longitudinal diameter of a hind ocellus. In contrast, typical members of the genus have ocellar setae III 2.3 or more times as long as the longitudinal diameter of a hind ocellus. This definition brings into the group such species as *Fr. bagnalliana* Hood, which have short setae on the head but longer pronotal setae; they also tend to have rather short antennae, particularly segments V and VI. When measuring setae it is essential that they are horizontal, or that allowance is made for any slope in orientation under the microscope coverglass. Similarly apparent head length is severely reduced if the head is tilted forwards.

KEY TO COSTA RICAN SPECIES OF THE MINUTA GROUP

1a. Pronotal am setae scarcely differentiated from the anteromarginal minor setae; ocellar setae III close together within the ocellar triangle,position 3/4 (fig. 5) .... *curta* Hood

1b. Pronotal am setae clearly longer than the minor setae.....2

2a. Antennal segment III pedicel with a subbasal ring or swelling; antennal segment

II swollen and with two long dorsal setae .....*diversa* Hood

2b. Antennal segment III with pedicel simple, antennal segment II never swollen but sometimes long, dorsal setae sometimes longer 3

3a. Antennal segment II sharply constricted at base, maximum diameter 2.0 times minimum diameter (fig. 1) ....*kiesteri* sp.n

3b. Antennal segment II not much narrower at base than apex.....4

4a Ocellar setae III in position 1/2 on anterior margins of ocellar triangle (fig. 5).....5

4b. Ocellar setae III in position 2 or within the ocellar triangle (fig. 5) 6

5a. Metanotum without campaniform sensilla; tergite IX setae B1 shorter than B2 (94-115: 230-280 microns)..... .....*minuta* Moulton

5b. Metanotal campaniform sensilla present; tergite IX setae B1 and B2 subequal in length; pronotal posteromarginal seta B4 longer than B3 & B5; antennal segments III-IV paler than II or V (fig. 2)..... .....*hansoni* sp. n.

6a. Female tergite IX seta B1 equal to or longer than tergite X.....7

6b. Tergite IX setae B1 shorter than the length of tergite X.....10

7a. Pronotal setae aa more than 35 microns long 8

7b. Pronotal setae aa less than 30 microns long 9

8a. Head with postocular setae I absent; tergite IX setae B1 65 microns long; pronotal aa setae 37 microns long...*floydandrei* Sakimura & O'Neill.

8b. Head with postocular setae I present; tergite IX setae B1 more than 80 microns long; pronotal setae aa more than 48 microns long (fig. 3)*vargasi* sp.n

9a. Body colour dark brown including femora, mid and hind tibiae yellow; antennal segments I & II dark, III & IV mainly yellow.....*cotobrusensis* sp.n

9b. Body colour yellow with greyish brown shadings, mid and hind legs not sharply bicoloured; antennal segment I yellow, II-VIII mainly light brown.....*zurqui* sp.n

10a. Pronotum with median discal setae 5-7 microns long; postocular setae I absent (fig. 4); male dark brown, similar in colour to female.....*montanosa* sp. n

10b. Pronotum with median discal setae 12-17 microns long; postocular seta I present; male yellow .....*bagnalliana* Hood

Frankliniella bagnalliana Hood, 1925: 79

Female body colour brown; tibiae variable, yellow to brown; forewings shaded; antennal segments I - II yellow to brown, III-V yellow, VI brown with base pale. Head with ocellar setae III in position 2; postocular setae I present. Pronotum with 1 pair of anteromarginal minor setae; discal area with weak transverse lines of sculpture. Ctenidia of tergite IV with few teeth. Comb of tergite VIII slender and long with closely separated teeth.

Measurements (microns). Head: length 103; width 141; seta io III 26; seta po IV 24. Antennal segments II-VIII: 31, 46(pedicel 7), 38, 30, 36, 5, 10. Pronotal setae: am 48; aa 53; pm I 19; pm II 36; pm IV 14; pm VI 58; pm VIII 55. Forewing length 674. Tergite IX setae: B1 67; B2 69. Tergite X length 77. Tergite VIII comb 12.

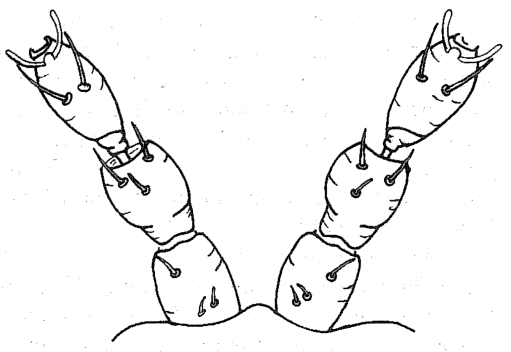

Fig. 1. Frankliniella kiesteri, III segmento de la antena.

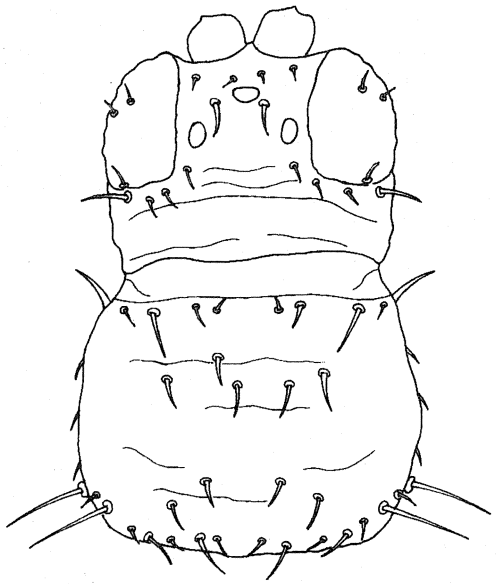

Fig. 2. *Frankliniella hansoi,* pronoto.

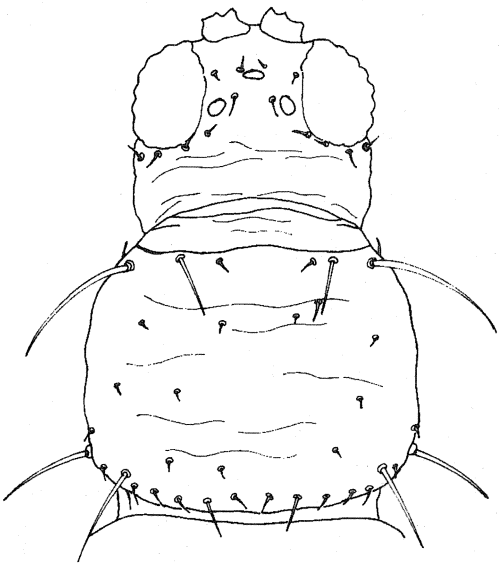

Fig. 4. Frankliniella montanosa, pronoto.

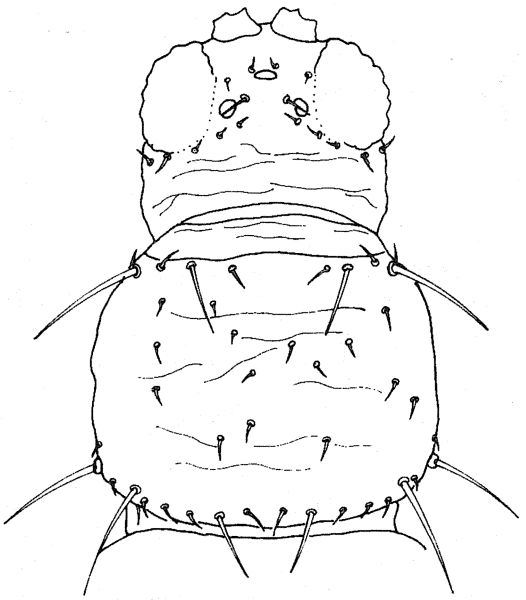

Fig. 3. *Frankliniella vargasi,* pronoto.

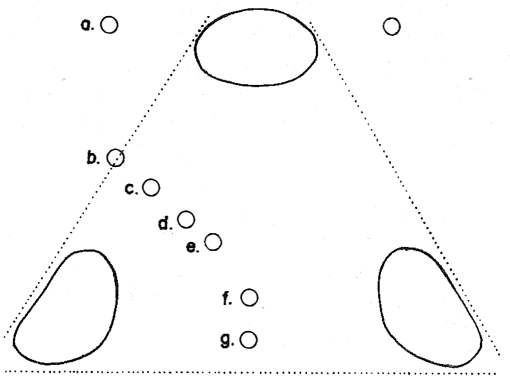

Fig. 5. Diagarama de la posición de las setas i o III. a. I; b. 1/2; c. 2; d. 2/3; e. 3; f. 3/4; g. 4.

Male body yellow; sternites III-VII with a glandular area 20-35 microns in diameter; tergite VIII without comb.

MATERIAL. Panama: holotype on unknown host, Boquete, II-1914, deposited in USNM. Costa Rica: collected in *Senecio, Eupatorium,* Cartago, IX-1991; *Senecio, Eupatorium, Mirandella,* Cerro de la Muerte, IX-1991; *Senecio megaphyllus,* unknown host I-1976; unknown host, Volcán Poás, IV-1975; Apiaceae, Asteraceae, Poás, VI-1983; *Eupatorium,* Monte Verde, VII-1983; *Hypericum strictum, Vaccinium consanguineum,* Villa Mills, VI-1989; *Senecio,* Volcán Irazú, III-1991; unknown host, San Vito, Las Alturas, IX-1991; Asteraceae, San José, Universidad de Costa Rica, I-1991; deposited in MIUCR and BMNH.

COMMENTS. The type locality of this species is Bajo Boquete, in the highlands of Panama near Costa Rica. In Costa Rica it occurs in Asteraceae flowers of many localities in high lands. The tibiae of this species are remarkably variable in colour, from yellow to brown, even within single populations.

Frankliniella curta Hood, 1942: 654

Female body colour light brown when mature, including legs; forewing shaded; antennal segment III yellow, IV shaded at apex, I-II & V-VIII brown. Head with seta io III very close to position 3/4; postocular seta I present. Antennal segment III with simple pedicel, collar absent. Pronotal sculpture with fine transverse lines; with a pair of am minor setae. Ctenidia of tergite IV with few teeth; comb of tergite VIII long and slender with closely separated teeth.

Measurements (microns). Head: length 91; width 120; seta io III 12; seta po IV 12. Antennal segments II-VIII: 24, 38 (pedicel 5), 31, 24, 36, 5, 10. Pronotal setae: am 12; aa 29; pm I 14; pm II 24; pm IV 12; pm VI 36; pm VIII 36. Forewing length 522. Tergite IX setae: B1 46; B2 48. Tergite X length 72. Tergite VIII comb 14.

MATERIAL.Trinidad: Holotype in bush at cocoa plantation 30-III-1915, deposited in USNM. Costa Rica: collected in *Senecio flowers*, Cerro de la Muerte, 29-IX-1991, deposited in MIUCR and BMNH.

COMMENTS. This species easily distinguished from related species because the major anteromarginal setae are very small and difficult to distinguish from the minor setae. Collected in Asteraceae flowers in Trinidad, Brasil and Perú (Sakimura & O'Neill, 1979).

Frankliniella diversa Hood, 1935: 160.

Female body colour brown, including legs; forewings shaded; antennal segment III yellow, IV shaded at apex. Head with seta io in position 3; postocular seta I present. Antenna with segment II medially swollen and the pedicel of segment III with sub-basal angular ring. Pronotal sculpture with transverse lines slender; with a pair of am minor setae. Ctenidia of tergite IV absent; comb of tergite VIII long with sparsely placed teeth.

Measurements (microns). Head: length 96; width 149; seta io III 48; seta po IV 14. Antennal segments II-VIII: 29, 41 (pedicel 7, width of ring 7), 41, 33, 45, 10, 12. Pronotal setae: am 31; aa 24; pm I 14; pm II 26; pm IV 14; pm VI 55; pm VIII 48. Forewing length 617. Tergite IX setae: B1 84; B2 91. Tergite X length 55. Tergite VIII comb 10.

MATERIAL. (holotype female from Panama not seen, in USNM). Costa Rica: one female collected in Inga flowers, Guápiles, 6-IX-1991, deposited in MIUCR.

COMMENTS. Hood (1935) distinguished this species by the shape of antennal segment II, which is medially swollen. In general, it resembles *parvula, zeteki* and *standleyana.* In Costa Rica it was collected in Guápiles, a moist habitat different from the dry branches mentioned for Panama. Also present in Costa Rica is another species with antennal segment II swollen, but distally, here named *kiesteri* sp.n.

Frankliniella floydandrei Sakimura & O'Neill, 1979: 20

Female body colour light brown, tibiae yellow; forewings weakly shaded; antennal segments III - V yellow, other segments brown. Head with seta io III in position 1/2; postocular seta I absent. Pedicel of antennal segment III simple. Pronotum without medial sculpturing; a pair of am minor setae. Ctenidia of tergite IV present, with few teeth; comb of tergite VIII long with sparsely placed teeth.

Measurements (microns). Head: length 89; width 137; seta io III 12; seta po IV 12. Antennal segments II - VIII: 31, 41 (pedicel 5), 36, 31, 38, 7, 12. Pronotal setae: am 31; aa 38; pm I 12; pm II 29; pm IV 12; pm VI 50; pm VIII 48. Forewing length 503. Tergite IX setae: B1 67; B2 77. Tergite X length 55. Tergite VIII comb 14.

MATERIAL. Panama: Holotype collected in grass, Canal Zone, 2-XI-1912, deposited in USNM.

COMMENTS. Collected in grassland around the Canal of Panama. Sakimura & O'Neill

(1979) distinguish it basically by colour, but the holotype is possibly teneral. The absence of postocular seta I is difficult to assess. Included here because of geographic position and affinity with Costa Rican *vargasi* sp.n.

Frankliniella vargasi Retana & Mound, new species (fig. 3)

Female body colour light brown, fore femora pale, mid and hind femora dark, mid and hind tibiae bicolored; forewing with dark pigmentation, weak and variably pale at base. Antennal segments I - II & V - VIII dark brown, III brownish yellow, IV distinctively shaded, pale at base. Head with seta io III in position 2, but close to posterior ocelli and sometimes in position 3/4; postocular seta I present. Pedicel of antennal segment III simple. Pronotal sculpture with strong transverse lines; with a pair of am minor setae; campaniform sensillae of metanotum present. Ctenidia of tergite IV present, with few teeth; comb of tergite VIII long and slender with closely separated teeth.

Measurements (holotype in microns). Head: length 90; width 145; seta io III 30; seta po IV 18. Antennal segments II -VIII: 30, 45 (pedicel 7), 43, 30, 43, 7, 12. Pronotal setae: am 45; aa 48; pm I 15; pm II 30; pm IV 12; pm VI 60; pm VIII 45. Forewing length 650. Tergite IX setae: B1 90; B2 90. Tergite X length 70. Tergite VIII comb 9.

Male body yellow; sternites III - VII with a transverse thin glandular area ; tergite VIII without comb.

MATERIAL. Holotype female, Costa Rica: Guápiles, in *Senecio* flowers (yellow), 27.iv.1992 (LAM 2286), deposited in BMNH. Paratypes: 5 females 4 males collected with holotype; Costa Rica: Ciudad Colón, Finca el Rodeo, 8 females in *Calea* flowers, 19.xi.1991 (A.Retana); San Pedro de Montes de Oca, Universidad de Costa Rica, bosquecito, 6 females in Asteraceae flowers, 28.i.1991 (A.Retana), 8 females in *Montanoa,* 10.i.1992 (LAM 2180); Cerro de la Muerte, 1 female in Asteraceae flowers, 23.i.1992 (A.Retana), deposited in

MIUCR and BMNH; Heredia, San Antonio of Puriscal, 1 female in flowers of *Montanoa danicola*, 1.ii.1976 (E.Klein), deposited in SMF.

COMMENTS. Morphologically close to *floydandrei* but distinguished by presence of seta po I and by brown color, whereas *floydandrei* is brownish yellow. Found in many parts of Costa Rica, but highland specimens are larger than holotype and paratypes, which are lowland specimens. In addition to the type-series 6 females have been studied from *Verbena* flowers (Alajuela, Finca La Gloria, 26.i.1976, deposited in SMF) with antennal segments V & VI more extensively yellow; these may represent another species. Dedicated to Mario Vargas Vargas for his many years of work with small arthropods and his assistance with this study.

Frankliniella hansoni Retana & Mound, new species (fig. 2)

Female body colour dark brown; forewing with dark pigmentation, weak and variably pale at base; antennal segment III brownish yellow, IV distinctively shaded, pale at base . Head with seta io III in position 1 or 1/2; postocular seta I present. Antennal pedicel segment III simple. Pronotal sculpture absent medially; with a pair of am minor setae; campaniform sensillae of metanotum present. Ctenidia of tergite IV present, with few teeth; comb of tergite VIII long and slender with closely separated teeth.

Measurements (holotype in microns). Head: length 110; width 148; seta io III 15; seta po IV 15. Antennal segments II -VIII: 29, 45 (pedicel 7), 38, 33, 45, 9, 15. Pronotal setae: am 21; aa 21; pm I 15; pm II 27; pm IV 21; pm VI 45; pm VIII 45. Forewing length 800. Tergite IX setae: B1 90; B2 95. Tergite X length 90. Tergite VIII comb 15.

Male body dark brown; sternites III - VII with a small circular glandular area, 15 microns in diameter; tergite VIII with a long comb.

MATERIAL. Holotype female, Costa Rica, San José, Sabanilla, soccer field of Universidad de Costa Rica, in flowers of *Verbesina turbaiensis,* 21.i.1992 (LAM 2207), deposited in BMNH. Paratypes: 4 females collected with holotype; San Pedro, Universidad de Costa Rica, 2 females in flowers of *Montanoa,* 8 & 10.i.1992 (LAM 2177 & 2180); Cerro de la Muerte, 2 females in Asteraceae flowers, 23.i.1992 (AR 1192); Volcán Irazú, 1 female in *Senecio flowers,* 30.iii.1991 (AR); Volcán Poás, 4 females in *Senecio* and *Eupatorium*

flowers, ii.1991 (AR), deposited in MIUCR & BMNH; Heredia, San Antonio de Puriscal, 13 females 3 males in *Montanoa danicola* flowers, 1.ii.1976 (E.Klein), deposited in SMF.

COMMENTS. This the only species in Costa Rica which is closely related to *minuta* in having ocellar setae III in position 1/2. However, *hansoni* has paired campaniform sensilla on the metanotum, in contrast to *minuta*. Collected on many Asteraceae in highland sites in Costa Rica. It is named in honour of Paul Hanson in recognition of his active support for this project.

Frankliniella kiesteri Retana & Mound, new species (fig. 1)

Female body dark brown, antennal segment III & IV brownish yellow ; fore wings weakly shaded with brown, variably weak pale at base; tibia shaded with brown; setae dark brown. Head with seta io III in position 3/4; postocular seta I absent. Antenna with segment II apically swollen, pedicel of antennal segment III simple, without medial swelling. Pronotal sculpture with strong transverse lines ; with a pair of am minor setae. Campaniform sensillae of metanotum present. Ctenidia of tergite IV present, with many teeth; comb of tergite VIII long and slender with closely separated teeth.

Measurements (holotype in microns). Head: length 105; width 150; seta io III 21; seta po IV 12. Antennal segments II -VIII: 31, 43 (pedicel 7), 38, 27, 38, 6, 6. Pronotal setae: am 50; aa 55; pm I 17; pm II 45; pm IV 17; pm VI 72; pm VIII 65. Forewing length 850. Tergite IX setae: B1 63; B2 110. Tergite X length 5; Tergite VIII comb 15.

Male body yellow; sternites III - VII with a very large transverse glandular area; tergite VIII without comb.

MATERIAL. Holotype female, Costa Rica, Monteverde, in *Eupatorium* flowers, 12.vii.1983 (R.Keister), deposited in BMNH. Paratypes: 9 females 1 male collected with holotype, deposited in MIUCR and BMNH.

COMMENTS. Distinguished by apical swelling of antennal segment II. Found in Pacific highlands in Asteraceae.

Frankliniella minuta (Moulton)
Euthrips minutus Moulton, 1907: 56

Female body colour brown, including legs; forewing dark, variably paler at base; antennal segment III pale brown at base. Head with seta io III in position 1/2; postocular seta I absent. Pedicel of antennal segment III simple. Pronotal sculpture with strong transverse lines; with a pair of am minor setae. Ctenidia of tergite IV present; comb of tergite VIII long and slender with closely separated teeth.

Measurements (microns). Head: length 84; width 127; seta io III 12; seta po IV 12. Antennal segments II - VIII: 24, 33 (pedicel 5), 36, 26, 38, 7, 12. Pronotal setae: am 17; aa 17; pm I 10; pm II 29; pm IV 21; pm VI 43; pm VIII 36. Forewing length 712. Tergite IX setae: B1 55; B2 103. Tergite X length 72. Tergite VIII comb 17.

Male body dark brown; sternites III - VII with a transverse glandular area; tergite VIII with a long comb.

MATERIAL. (Holotype not seen) Specimens collected in *Senecio, Eupatorium,* Volcán Poás, Alajuela, II-1991. *Senecio,* Zurquí, Braulio Carrillo, Heredia, II-1991. *Calea,* Finca "El Rodeo", Ciudad Colón, San José, XI-1991. *Columnea*, Estación Biológica La Selva, Sarapiqui, Heredia, IX-1991. Sunflowers, Zapote, San Jose, Costa Rica, I-1992. Material deposited in MIUCR and BMNH. Specimens collected by A. Retana and L.A. Mound.

COMMENTS. Sakimura & O'Neill (1979) state that both sexes have the same body color and pronotal sculpture, except pale specimens have weaker ornamentation. Immatures are light with a dark cauda. They mention the species from the United States, Mexico, Guatemala, Panama, Peru and the Hawaiian islands, in accordance with Mound & Palmer (1992), but large lots have been collected in Costa Rica by Retana. Sakimura & O'Neill (1979) reported 57 host plants; six are known from Costa Rica, always in flowers (mostly Asteraceae). Diagnostic characters include the position of setae io III, pronotal ornamentation, the absence of metanotal campaniform sensilla and the absence of developed anteroangular seta; also the length of setae B2 with respect to setae B1 on abdominal segment IX of abdomen

Frankliniella montanosa Retana & Mound, new species (fig. 4)

Female body dark brown, tibiae shaded with brown; hind wings lightly shaded, weak and variably pale at base; antennal segments III and IV brownish yellow. Head with seta io III close, in position 3/4; postocular seta I absent; pedicel of antennal segment III simple without swelling. Pronotal sculpture with fine transverse lines; with a pair of am minor setae. Campaniform sensillae of metanotum present. Ctenidia of tergite IV present, with many teeth; comb of tergite VIII long and slender with closely separated teeth.

Measurements (holotype in microns). Head: length 125; width 165; seta io III 18; seta po IV 18. Antennal segments II -VIII: 35, 55 (pedicel 7), 48, 33, 45, 7, 7. Pronotal setae: am 48; aa 53; pm I 15; pm II 37; pm IV 15; pm VI 70; pm VIII 75. Forewing length 1000. Tergite IX setae: B1 63; B2 110. Tergite X length 90. Tergite VIII comb 17.

Male body dark brown ; sternites III - VII with a very large transverse glandular area ; tergite VIII without comb.

MATERIAL. Holotype female, Costa Rica, 25km South of Cartago, Cerro de la Muerte, in *Mirandella* flowers, 1800m, 29.ix.1991 (AR 12991), deposited in BMNH. Paratypes: 5 females 10 males collected with holotype; Cerro de la Muerte, Villa Mills, 3000 meters, 2 females 1 male in *Maianthemum paludicola* flowers, 15.vi.1989 (LAM 2041); Monteverde, 5 females in *Eupatorium* flowers, 12.vii.1983 (R.Keister), deposited in MIUCR and BMNH.

COMMENTS. Collected only at three sites in Costa Rica, in different years on two highland genera of Asteraceae. Close to *bagnalliana* but its pronotal discal setae are small and seta po I is absent. The metanotal sculpture forms a distinct longitudinal triangle medially. Male and female brown, while *bagnalliana* has yellow males and brown females

Frankliniella cotobrusensis Retana & Mound, new species

Female body dark brown, tibiae shaded with brown; fore wings with dark pigmentation, weak and variably pale at base; antennal segments III and IV yellow, V strongly shaded on apex. Head with setae io III in position 2/3/4; postocular I present; pedicel of antennal segment III simple without swelling. Pronotal sculpture absent medially; with a pair of am minor setae. Campaniform sensillae of metanotum present. Ctenidia of tergite IV present, with few teeth; comb of tergite VIII long and slender with teeth closely separated.

Measurements (holotype in microns). Head: length 90; width 140; seta io III 12; seta po IV 12. Antennal segments II -VIII: 33, 42 (pedicel 7), 36, 30, 42, 7, 12. Pronotal setae: am 25; aa 21; pm I 15; pm II 33; pm IV 17; pm VI 50; pm VIII 45. Forewing length 650. Tergite IX setae: B1 85; B2 85. Tergite X length 65. Tergite VIII comb 15.

Male unknown.

MATERIAL. Holotype female, Costa Rica, San Vito de Coto Brus, Jardín Botánico Wilson, in Asteraceae flowers (white), 18.ix.1991 (LAM 2151), deposited in BMNH. Paratypes: 18 females collected with holotype; 20km South of Cartago, Cerro de la Muerte, 2 females in *Eupatorium* flowers, 8.ix.1991 (LAM 2119), deposited in MIUCR and BMNH.

COMMENTS. Collected only at two sites in Costa Rica. It is similar to *zurqui* in having short pronotal setae, but antennal segments III-IV are pale in contrast with other segments, body dark brown.

Frankliniella zurqui Retana & Mound, new species

Female body light brown or yellow weakly shaded ; femora and tibiae shaded with brown; fore wings uniformly dark; antennal segment I yellow, II-VIII dark brown. Head with seta io III in position 2; postocular seta I absent; pedicel of antennal segment III simple without swelling. Pronotal sculpture with slender transverse lines; with a pair of am minor setae. Campaniform sensillae of metanotum present. Ctenidia of tergite IV absent; comb of tergite VIII long with sparsely located teeth.

Measurements (holotype in microns). Head: length 100; width 135; seta io III 21; seta po IV 15. Antennal segments II -VIII: 33, 39 (pedicel 7), 33, 27, 40, 7, 12. Pronotal setae: am 18; aa 18; pm I 12; pm II 27; pm IV 12; pm VI 45; pm VIII 42. Forewing length 600. Tergite IX setae: B1 65; B2 70. Tergite X length 60. Tergite VIII comb 15.

Male body yellow; tergite VIII with a long comb; sternites III - VII with a thin transverse glandular area.

MATERIAL. Holotype female, Costa Rica, Zurquí, Braulio Carillo, in *Polygonum* flowers, 1800m, 7.ix.1991 (LAM 2113), deposited in BMNH. Paratypes 10 females 4 males collected with holotype, deposited in MIUCR and BMNH.

COMMENTS. Seems close to *cotobrusensis,* but antennae totally dark and body of both sexes dark yellow. Male tergite VIII curiously with comb as in female.

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