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**Scirtothrips** species (Thysanoptera: Thripidae) described from *Mangifera indica* (Anacardiaceae) in Mexico

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**Abstract**

A series of 15 species described from specimens collected from the leaves of mango trees at a single site in Mexico are newly placed as synonyms of the California citrus thrips, *Scirtothrips citri* (Moulton) (Thysanoptera: Thripidae). These species were originally discriminated based on differences in the precise placement of setae in the median area of the pronotum, and this chaetotaxy is here recognized as variable within populations of this thrips from various sites in California and Mexico. Preliminary results from molecular analysis of 2 genes, CO1 and 28S-D2, indicate that there is variation at the molecular level between populations of *S. citri*. However, this variation is not sufficient to support new species designations, and no consistent morphological divergence between these populations was detected.

**Key Words:** new synonyms; *Scirtothrips citri*; quarantine

**Materials and Methods**

We re-assessed the morphological character states used by Johansen & Mojica-Guzman (1999) to distinguish species of *Scirtothrips* from mango in Mexico. We compared these published data with variation we observed within populations of *Scirtothrips citri* (Moulton) at Riverside, California, and Chiapas, Mexico, and also on paratypic specimens loaned by R. M. Johansen (Universidad Nacional Autónoma de México). DNA was extracted from 4 *Scirtothrips* specimens collected from mango flowers at Chiapas, Mexico, and data from 2 genes, CO1 and 28S-D2, were compared with published data on *S. citri* from California (USA) and Oaxaca (Mexico).

**Results and Discussion**

**MORPHOLOGICAL DATA**

In assessing the morphological diversity of a sample of thrips, the appropriate null hypothesis would be that all *Scirtothrips* specimens

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Table 1. *Scirtothrips* species described from mango at a single site in Mexico (El Guaco, Sierra Madre del Sur, Michoacan).

| Species               | Dates of collection (all except one in 1998) | Type series |
|-----------------------|---------------------------------------------|-------------|
| *admangiferaffinis*   | 9.iii.1998, 10.ii.; 25.ii.; 24.iii.          | 40          |
| *apatzinganensis*     | 9.iii.1998, 10.ii.; 15.vii.                 | 3           |
| *dieterenkerlini*     | 24.iii.1998, 10.ii.; 25.ii.                 | 5           |
| *dieteronozolezi*     | 10.ii.1998, 25.ii.                          | 3           |
| *mangiferaffinis*     | 21.v.1997, 10.ii.; 25.ii.; 9.iii.; 24.iii.; 15.vii. | 34          |
| *mangofrequentis*     | 9.iii.1998, 24.iii.                         | 3           |
| *mangoinfestans*      | 9.iii.1998, 10.ii.; 25.ii.; 24.iii.; 15.vii. | 25           |
| *mangomolestus*       | 9.iii.1998, 24.iii.                         | 4           |
| *mangorum*            | 9.iii.1998, 24.iii.; 15.vii.                | 11           |
| *mangonoxius*         | 10.iii.1998, 10.ii.                         | 6           |
| *martingonzalezi*     | 24.iii.1998                                | 1           |
| *novomangorum*        | 25.ii.1998, 10.ii.; 9.iii.                 | 3           |
| *willihennigi*        | 10.ii.1998, 9.iii.                          | 2           |

*Paratype studied iii.2016.*

Ocellar setae pair I arise in front of the 1st ocellus on the downward sloping anterior margin of the head, and thus in well-prepared slide-mounted specimens these setae are never orientated in a suitably horizontal state for their length to be measured accurately (unless the head is flattened by crushing under the cover slip). Because these setae project vertically, their length in undamaged specimens cannot be measured with sufficient precision for use as an effective species discriminant. Ocellar setae pair III were categorized by the authors as either “within” or “on anterior margins of” the ocellar triangle. However, such a distinction is not clear because the “anterior margin of the triangle” can be interpreted as being the tangent on the outer margins of the ocelli, or on their inner margins, or as being a line joining the mid points of the ocelli (see Fig. 5 in Retana & Mound 1995). Ocellar setae pair III are stated to be on the margins of the triangle in *dieterenkerlinii* (Fig. 14) but within the triangle in *mangorum* (Fig. 15), although the illustrations provided fail to show a clear distinction. Moreover, these 2 setae are commonly positioned asymmetrically in undamaged mounted specimens (Fig. 16). Thus, neither of these ocellar setae characters provides an unequivocal state for distinguishing species among mango-inhabiting *Scirtothrips*. These characters are not considered further as reliable morphological traits to distinguish species, although in some other genera of Thripidae they can be suitable as species discriminants.

**TAXON DISCRIMINATION**

Johansen & Mojica-Guzman (1999) distinguished a group of 30 *Scirtothrips* species from Mexico as belonging to a “*citri* group,” and this included the 15 species from mango listed in Table 1. Of these 15 species, 3 were further placed amongst 14 species designated as a “*citri* assemblage,” 9 were listed amongst the 11 species of a “*mangofrequentis* assemblage,” and 3 were listed amongst the 4 species of the “*dieterlenzii* assemblage.” Subsequently, flaws in this classification became evident, because 5 of the 14 species in the “*citri* assemblage” were recognized as synonyms of *S. perseae* (Hoddle et al. 2008a). This species, the avocado thrips, has dark tergal antecostal ridges and the males have drepanae on the 9th tergite, in contrast to the uniformly pale *citri* in which males do not have drepanae. Males (where known) of all the nominal species considered here in association with mango leaves do not have drepanae. However, 1 species, *chamelaelansis*, listed as a member of the “*mangofrequentis* assemblage,” is clearly un-related to the “*citri* group” because the male has drepanae on tergite IX.

The members of the “*citri* assemblage” were distinguished by the presence on the pronotum of a “median transverse setae row forming a straight line, either continuous or with a median gap,” and 3 species from mango were said to share this character state with *citri*. Two of them, *apatzinganensis* (Fig. 9) and *martingonzalezi* (Fig. 10), were considered to have “a gap at middle” in this setal row, in contrast to *mangonoxius* (Fig. 2) that was stated to have the setal row “regularly continuous,” as claimed also for *citri* itself (Fig. 1). The “*dieterlenzii* assemblage” and the “*mangofrequentis* assemblage” were distinguished from the “*citri* assemblage” solely because the median transverse setal row has either 1 (Fig. 3) or 2 (Fig. 8) setae displaced to the posterior. However, the original illustrations, reprinted here, provide no clear support for these statements. A simpler interpretation of the situation would be that the precise positions and number of setae on the pronotal disc are not constant between individuals.

The setae designated as a sub-antemarginal row were stated by Johansen & Mojica-Guzman (1999) to be lacking in *mangofrequentis* (Fig. 6) and *novomangorum* (Fig. 11), but present in *mangoinfestans* (Fig. 8), *dieterenkerlinii* (Fig. 12), and *mangorum* (Fig. 13). In the illustrations provided, such a row of setae cannot be recognized unambigu-
Mound & Hoddle: *Scirtothrips* species from mango in Mexico

ously, and this character state seems to be largely subjective. The possibility that the discal setae on the pronotum do not have any precise positions was therefore considered. To this end, the pronotal chaetotaxy was examined: on a paratype of each of 10 species (loaned by R. M. Johansen, Universidad Nacional Autónoma de México); on a series of *Scirtothrips* specimens collected from mango at Chiapas, Mexico; and on a series of *S. citri* specimens collected from citrus and mango in California.

**DATA FROM PARATYPES**

Comparison of the chaetotaxy of the pronota of the available paratypes (Figs. 17–22) with that of the illustrations of the relevant holotypes (Figs. 1–13) indicates that there is general agreement concerning the position of the median 1 or 2 pairs of setae. However, the precise positions of these setae, and the precise positions of the surrounding setae on the median area of the pronotum, are clearly not constant between these paratypes and the illustrated holotypes. This lack of consistency suggests that the arrangement of all the setae on the median area of the pronotum is not rigidly constrained as interpreted by Johansen & Mojica-Guzman (1999), and is therefore not a reliable morphological character for recognizing and separating species.

**DATA FROM RECENTLY COLLECTED SPECIMENS**

The pronotal chaetotaxy of the common pest, the California citrus thrips, *S. citri*, includes with remarkable consistency a longitudinal row of 3 setae on each side of the pronotum close to the extreme lateral margins. Median of each of these rows there is usually a 2nd longitudinal row, but of 2 setae (Figs. 23–25). Apart from these 2 groups of setae, the remaining discal setae of *citri* specimens from California appear to be arranged irregularly, and we were not able to detect any clear repeatable patterns. Between the lateral setae, the discal area has 4 to 10 setae, but these do not form 2 recognizable “sub-anteromarginal” or “median transverse” rows. One or both of the anteromarginal setae (Figs. 23–28) is commonly displaced posteriorly (or even entirely absent), and 1 or more of the median discal setae is commonly displaced anteriorly and thus becomes part of a putative “sub-anteromarginal row.” The pronotum of specimens from Chiapas (Figs. 26–28), identified here as *citri*, has essentially the same arrangement of setae as *citri* specimens from California (Figs. 23–25), with the same paired lateral rows but irregular discal chaetotaxy. The available specimens from California tend to have rather fewer median discal setae on the pronotum than specimens from Mexico, and this might be a sampling artifact or a population difference. Certainly, this thrips species seems to exhibit unusual variation in the number of pronotal discal setae.

**Figs. 1–16. Scirtothrips pronota (1–15, copied from Johansen & Mojica-Guzman 1999). 1, *citri*; 2, *mangonaxius*; 3, *danieltelizi*; 4, *mangoaffinis*; 5, *willihennigi*; 6, *mangofrequentis*; 7, *mangoferaaffinis*; 8, *mangoinfestans*; 9, *apatzinganensis*; 10, *martingonzalezii*; 11, *novomangorum*; 12, *dieterenkerlini*; 13, *mangorum*; 14, *dieterenkerlini*; 15, *mangorum*; 16, *citri*.**
Using *S. citri* specimens from citrus in California as a reference point, Hoddle et al. (2008b) identified *Scirtothrips* specimens taken from mango in Oaxaca, Mexico, as *S. citri*, using molecular data from the gene regions 28s-D2 and CO1. As part of the present study, DNA was extracted from 4 *Scirtothrips* females collected in Chiapas, southern Mexico, and the same 2 genes were assessed separately and compared with the data published by Hoddle et al. (2008b). Both of the analyzed genes placed these 4 females in the same major clade as *citri*, but with the specimens from Mexico as sister-group to the Californian specimens. Detected differences were not sufficient to declare the existence of different species. This result is not surprising, and more extensive studies are needed to examine the molecular variation of *citri* populations across the extensive geographic range of this species. Collections and analyses should include material from across the southern USA, from Florida to California, and throughout Mexico (Hoddle et al. 2012).

A similar problem exists with *S. perseae*, where molecular data indicated that a population from Honduras was a sister-group to that pest species (Hoddle et al. 2008b), although no structural differences could be recognized (Mound & Hoddle 2016). Molecular differences have been detected within some other widespread species, including *Frankliniella occidentalis* (Pergande), the western flower thrips (Rugman-Jones et al. 2010). However, such differences at the molecular level are rarely correlated with significant morphological and biologi-

Figs. 17–28. *Scirtothrips* pronota. 17–22 Paratype females on loan from Johansen: 17, *danieltelizi*; 18, *mangoaffinis*; 19, *willihennigi*; 20, *mangofrequentis*; 21, *mangiferaffinis*; 22, *mangoinfestans*. 23–28 Recent slide mounts: 23, *citri* from citrus at Riverside, California; 24–25, *citri* from mango at Riverside, California; 26–28, *citri* from mango at Chiapas, Mexico.
Mound & Hoddle: Scirtothrips species from mango in Mexico
cal differences, and morphospecies concepts remain the only practi-
cal approach for separating “pest” vs. “non-pest” variants of the same
species. One notable exception to this lack of correlation between mo-
lecular and field studies is work on populations of Scirtothrips dorsa-
lis Hood in Japan, which demonstrated the existence of crop-specific
strains of this pest that were separable using molecular data but not
morphologically (Toda et al. 2014).

CONCLUSIONS
We conclude that the data provided by Johansen & Mojica-Guzman
(1999) (see Figs. 1–15) do not adequately distinguish the 15 Scirto-
thrips species that they named from mango in Mexico. Similar patterns
of pronotal chaetotaxy have been observed between samples of the
common pest species, S. citri, from different sites and host plants, and
across time in California and Mexico (including Baja California, Sonora,
and Chiapas). Recognition amongst these specimens of the 3 discrete
groups of pronotal setae proposed by Johansen & Mojica-Guzman
(1999) has not proved possible. The 2 pairs of “anteromarginal setae”
are variable both in presence and position; the row of “sub-anteromar-
ginal setae” is not clearly distinguished from either the anteromarginal
or the median discal setae; and the “median transverse row of setae”
is usually an irregular arrangement of setae rather than a discrete row.
Thus, there is no consistent evidence that the arrangement of setae
on the median discal area of the pronotum is anything other than
random. Further, molecular-based data are not sufficiently different
across analyzed specimens to recognize different species, especially
without supporting biological data. Therefore, we conclude that there
is 1 Scirtothrips species, S. citri, that exhibits high levels of morpho-
logical intraspecific variation and these variants sympatrically inhabit
young mango leaves in Mexico.

All specimens that have been studied from Mexico and California on
mango and on citrus (including paratypes of 10 species in Table 1) share
the essential character states of the California citrus thrips, S. citri. These
include the uniformly pale color of the body and wings, the transverse
striation of the ocellar triangle, the presence of discal microtrichia on
the 8th and 9th tergites, and the absence of drepaeana in males. Given
the unreliability of the published data purporting to characterize the 15
species of Scirtothrips from mango in Mexico, and in the absence of any
alternative biologically based supporting evidence, these 15 species are
here formally placed into synonymy with S. citri. This decision has broad
economic implications, because S. citri is not only widespread in the
southern USA, it is highly polyphagous. In California in recent years, this
thrips has become a pest of blueberry crops, Vaccinium species (Erica-
cceae) (Havliland et al. 2009), and has been found seriously damaging
the young leaves of pistachio trees, Pistacia vera L. (Anacardiaceae) (J. Nay
& M. Hoddle personal observation).

If taxonomy is to provide a useful service to other biologists, then
the data and keys produced need to be tested independently and
“ground-truthed,” preferably by reviewers prior to publication
(O’Donnell & Mound 2016). The genus Scirtothrips is not the only ma-
ior Thysanoptera genus for which publications emanating from the
Universidad Nacional Autónoma de México involve problems in spe-
cies recognition. Hoddle et al. (2012) pointed out that Johansen (1987)
had recognized and described as a second species some of the spe-
cimens that came from a single experimental population of the preda-
tory thrips Leptothrips mali (Fitch). They further indicated that some
of the other Leptothrips species described in that 1987 paper were likely
to be synonyms as these were based on the presence or absence
of minor sense cones on the antennae that seemed liable to variation.
Similarly, character state assessments used in Mexico to distinguish
a large number of new species in the genus Frankliniella (references
in Johansen & Mojica-Guzman 2009) are often at variance with those
considered to be valid in this genus by other authors (Nakahara 1997;
Cavalleri & Mound 2012). As with the putative Leptothrips species, the
limited biological evidence available in support of these species sug-
gests that the reported biological diversity of Mexican thrips needs
further consideration.

SYNONYMIES

Scirtothrips citri (Moulton)
Euthrips citri Moulton 1909: 119
Scirtothrips admangiferennis Johansen & Mojica Guzman, 1999: 34. Syn.n.
Scirtothrips opatzenganensis Johansen & Mojica Guzman, 1999: 37. Syn.n.
Scirtothrips danieltelizi Johansen & Mojica Guzman, 1999: 44. Syn.n.
Scirtothrips dieterenkerlini Johansen & Mojica Guzman, 1999: 44. Syn.n.
Scirtothrips hectorgonzalezii Johansen & Mojica Guzman, 1999: 46. Syn.n.
Scirtothrips mangiferennis Johansen & Mojica Guzman, 1999: 48. Syn.n.
Scirtothrips mangoaennis Johansen & Mojica Guzman, 1999: 49. Syn.n.
Scirtothrips mangoaennis Johansen & Mojica Guzman, 1999: 50. Syn.n.
Scirtothrips mangoaennis Johansen & Mojica Guzman, 1999: 51. Syn.n.
Scirtothrips mangomolestus Johansen & Mojica Guzman, 1999: 52. Syn.n.
Scirtothrips mangonaxis Johansen & Mojica Guzman, 1999: 54. Syn.n.
Scirtothrips mangorum Johansen & Mojica Guzman, 1999: 53. Syn.n.
Scirtothrips martinogonzalezii Johansen & Mojica Guzman, 1999: 56. Syn.n.
Scirtothrips novomangorum Johansen & Mojica Guzman, 1999: 58. Syn.n.
Scirtothrips willihuennigi Johansen & Mojica Guzman, 1999: 67. Syn.n.

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