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**SYNONYMY OF *TOXOTRYPANA* GERSTAECKER WITH *ANASTREPHA*  
*SCHINER* (DIPTERA: TEPHRITIDAE)**

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*Abstract.*— Based on a recent phylogenetic analysis, *Toxotrypana* Gerstaecker (1860) is here placed in synonymy with *Anastrepha* Schiner (1868). Although *Toxotrypana* is the senior name, *Anastrepha* is recognized as valid because of the much greater economic significance of its species. Changing the names of the many pest species of *Anastrepha* would cause major nomenclatural instability and confusion in the applied literature, therefore a proposal to the International Commission on Zoological Nomenclature has been submitted to validate this usage. The following nomenclatural changes are proposed: *Anastrepha australis* (Blanchard 1960), new combination, *Anastrepha curvicauda* (Gerstaecker 1860), new combination, *Anastrepha littoralis* (Blanchard 1960), new combination, *Anastrepha nigra* (Blanchard 1960), new combination, *Anastrepha picciola* (Blanchard 1960), new combination, *Anastrepha proseni* (Blanchard 1960), new combination, *Anastrepha recurcauda* (Tigrero 1992), new combination (all transferred from *Toxotrypana*), and *Anastrepha nigrina* Norrbom, new name for *Anastrepha nigra*

Norrbom and Korytkowski (2009). Some changes to the species group classification within *Anastrepha* are also discussed.

**Key Words:** fruit flies, taxonomy, nomenclature, new name, new combination

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*Toxotrypana* Gerstaecker (1860) is a small genus of fruit flies (Diptera: Tephritidae) restricted to the New World tropics and subtropics. Its species are presumed to be mimics of vespoid wasps due to their body shape, bright yellow and brown coloration, reduced setation, and their wing patterns with a broad, complete costal band. Despite their distinctive external appearance, the species of *Toxotrypana* have been known for some time to be closely related to *Anastrepha* Schiner (1868) on the basis of genitalic characters (Norrbom et al. 1999b).

*Anastrepha* and *Toxotrypana* together form a well-defined monophyletic group supported by both morphological (Norrbom et al. 1999b) and molecular studies (Han and McPheron 1997, McPheron et al. 1999, Han and Ro 2009). *Toxotrypana* also is clearly monophyletic (Norrbom et al. 1999b), but the status of *Anastrepha* has been uncertain. Some studies suggested that it might be paraphyletic, but were not conclusive due to limited taxon sampling or insufficient character evidence (McPheron et al. 1999, Norrbom et al. 1999b, Barr et al. 2005). Recently, however, Mengual et al. (2017) investigated relationships within the *Anastrepha/Toxotrypana* clade, utilizing sequence data from six DNA regions in a total of 150 species. Their results conclusively demonstrate that *Toxotrypana* arises within *Anastrepha*, confirming that *Anastrepha* as currently defined is paraphyletic. *Toxotrypana* is the sister group of the *cryptostrepha*

clade of *Anastrepha*, and this lineage is sister to the *tripunctata* group of *Anastrepha* (taxa *sensu* Norrbom et al. 2012).

The purpose of this publication is to formally recognize the synonymy of *Anastrepha* and *Toxotrypana* and to make changes to the names of the species impacted by this synonymy. Some changes to the species group classification within *Anastrepha* based on the results of the Mengual et al. (2017) analysis are also discussed.

#### MATERIALS AND METHODS

We follow the morphological terminology of White et al. (1999), except for the wing venation, which follows that of Cumming and Wood (2017).

#### RESULTS AND DISCUSSION

##### *Anastrepha* Schiner Synonymy

*Anastrepha* Schiner 1868: 263, type species *Dacus serpentinus* Wiedemann 1830, by original designation.

*Toxotrypana* Gerstaecker 1860: 191, type species *T. curvicauda* Gerstaecker 1860, by monotypy; **New synonym.**

*Acrotoxa* Loew 1873: 227, type species *Dacus fraterculus* Wiedemann 1830, by subsequent designation of Bezzi 1909: 280.

*Mikimyia* Bigot 1884: xxix, type species *M. furcifera* Bigot 1884 (= *curvicauda* Gerstaecker), by monotypy. **New synonym.**

*Pseudodacus* Hendel 1914a: 66, type species *Anastrepha daciformis* Bezzi 1909, by original designation (as subgenus of *Anastrepha*).

*Pseudodacus* Hendel 1914b: 13, type species *Anastrepha daciformis* Bezzi 1909, by original designation (as subgenus of *Anastrepha*). Pre-occupied by Hendel 1914: 66.

*Phobema* Aldrich 1925: 7, type species *P. atrox* Aldrich 1925, by original designation.

*Lucumaphila* Stone 1939: 340, type species *L. sagittata* Stone 1939, by original designation.

*Anastrepha* is the largest genus of Tephritidae in the New World, including nearly 300 valid species (Norrbom et al. 1999a, 2012, 2015), with additional new species in the process of description (Norrbom et al., in prep.). *Toxotrypana* currently includes seven valid species and a similar number of undescribed species (Norrbom et al. 1999a, 1999b). Both genera include agricultural pests, but *Anastrepha* is by far more economically important. *Toxotrypana curvicauda* Gerstaecker, commonly known as the papaya fruit fly, is a major pest of papaya (*Carica papaya* L.) in the circum-Caribbean area (White and Elson-Harris 1992, Norrbom 2004). It is invasive in Florida (Weems 1969). Other species of *Toxotrypana* are not considered to be economically significant.

Multiple species of *Anastrepha*, including at least three members of the *A. fraterculus* (Wiedemann) complex (South American fruit fly), *A. grandis* (Macquart) (South American cucurbit fruit fly), *A. ludens* (Loew) (Mexican fruit fly), *A. obliqua* (Macquart) (West Indian fruit fly), *A. serpentina* (Wiedemann) (sapote fruit fly), *A. striata* Schiner (guava fruit fly), and *A. suspensa* (Loew) (Caribbean fruit fly) are major pests, impacting

commercial and subsistence crops such as citrus, guava, mango, melon, and many others (White and Elson-Harris 1992, Norrbom 2004). Numerous other species are minor or potential pests. Several species are invasive, including *A. fraterculus* (Brazil-1 type in Argentina, Bolivia and Peru), *A. grandis* (Panama), *A. ludens* (Panama), and *A. suspensa* (Florida) (Weems 1965, 1966; Sutton et al. 2015).

Despite differences in their external appearance, *Toxotrypana* and *Anastrepha* have been considered to be closely related on the basis of genitalic characters (Norrbom et al. 1999b). Although it has been clear that together they form a monophyletic group, both have continued to be recognized as genera because of the distinctiveness of *Toxotrypana* (based on numerous autapomorphies) and the uncertainty of the exact relationship of the two taxa, particularly whether or not *Anastrepha*, *sensu lato*, is monophyletic.

Based on the results of the phylogenetic analysis by Mengual et al. (2017) that *Anastrepha*, *sensu lato*, is paraphyletic, we here formally recognize the synonymy of *Anastrepha* and *Toxotrypana*. Although *Toxotrypana* has priority, *Anastrepha* has far greater economic importance and treating the latter as invalid would cause tremendous nomenclatural instability and disrupt scientific communication regarding multiple major pest species. Thus, we recognize *Toxotrypana* as a subjective synonym of *Anastrepha*. A proposal to the International Commission on Zoological Nomenclature has been submitted to validate this usage (Norrbom et al. 2018). The species previously classified in *Toxotrypana* are henceforth recognized as the *curvicauda* species group of *Anastrepha*.

The *nigra* subgroup of the *robusta* group was recognized by Norrbom and

Korytkowski (2009) to include *A. nigrina* Norrbom (as *A. nigra* Norrbom and Korytkowski; see Nomenclatural Changes) and *A. partita* Norrbom and Korytkowski. This clade was erroneously omitted from the Norrbom et al. (2012) species group classification. Based on the results of the Mengual et al. (2017) analysis, it is recognized here as a separate species group (like most of the subgroups of the *robusta* group), and it is here renamed the *nigrina* group to reflect the change in name of its namesake included species.

The *cryptostrepha* group was proposed by Norrbom and Kim (1988) and Norrbom et al. (1999b) to include *Anastrepha cordata* Aldrich, *A. cryptostrepha* Hendel, *A. margarita* Caraballo, *A. panamensis* Greene, *A. tripunctata* Wulp, and *A. zeteki* Greene. It was considered a subgroup of the *robusta* group by Norrbom and Korytkowski (2009) and Norrbom et al. (2012), and restricted to *A. cordata* and *A. cryptostrepha*, plus two new species, *A. cryptostrephoides* Norrbom and Korytkowski and *A. disticrux* Norrbom and Korytkowski. The three species treated by Mengual et al. (2017) formed a monophyletic group apart from the other subgroups of the *robusta* group and the subgroup was therefore recognized as a separate species group.

The other species originally included in the *cryptostrepha* group were placed in new species groups by Norrbom et al. (2012). Although no explanation was provided with that list, the division of the species followed the hypotheses of relationship within the original *cryptostrepha* group discussed by Norrbom et al. (1999b). *Anastrepha margarita*, *A. panamensis*, and *A. zeteki* were placed in the *panamensis* group, whereas *A. tripunctata* was included with *A. maya* Hernández-Ortiz and *A. relictata* Hernández-Ortiz (the “two n. spp. nr. *tripunctata*” of Norrbom et al. 1999b) in the *tripunctata*

group. Norrbom et al. (2014) added *A. tehuacana* Norrbom to the latter group, and Norrbom et al. (2015) added *A. disjuncta* Norrbom to the former group.

The *cryptostrepha* group, as originally proposed, was based on similarities in the shape of the male surstyli (character polarity uncertain) and aculeus tip (apomorphic, but not unique), reduced scutal microtrichia (apomorphic, but not unique), and weak apical curvature of vein  $M_1$  (plesiomorphic). Results of the Mengual et al. (2017) analysis indicate that the *cryptostrepha* group, *sensu lato*, is not monophyletic and that these morphological characters are homoplasious. Their analysis supports the Norrbom et al. (2012) classification of these species. The lone representative of the *tripunctata* group, *A. tehuacana*, is placed in the Mengual et al. (2017) analysis as the sister group of the *cryptostrepha* group, *sensu stricto*, plus the *curvicauda* group (former *Toxotrypana*), but the *panamensis* group is clustered with *A. punctata* Hendel, rather distant from this clade.

#### Nomenclatural Changes

The following nomenclatural changes are necessary because of the synonymy of *Toxotrypana* with *Anastrepha*, including transfer of the seven valid species originally described in *Toxotrypana* which are hereby transferred to *Anastrepha*, and one replacement name:

#### *Anastrepha australis* (Blanchard), new combination

*Toxotrypana australis* Blanchard 1960: 34. Syntype females (Museo Argentino de Ciencias Naturales). Type locality - Argentina: Tucumán: Tucumán. Distribution - Argentina (Buenos Aires, Corrientes, Santa Fe,

Santiago del Estero, Tucumán), Bolivia (Tarija), Brazil (Rio Grande do Sul).

*Anastrepha curvicauda* (Gerstaecker),  
**new combination**

*Toxotrypana curvicauda* Gerstaecker 1860: 194. Type female (Museum für Naturkunde der Humboldt Universität zu Berlin). Type locality - Virgin Islands: Insula St. Jean [St. John]. Distribution - Bahamas, Belize, Colombia, Costa Rica, Cuba, Dominican Republic, Netherlands Antilles, El Salvador, Guatemala, Honduras, México (Chiapas, Morelos, Oaxaca, Tamaulipas, Veracruz), Panamá, Puerto Rico, Trinidad, USA (southern Texas), Venezuela, Virgin Islands; introduced USA (Florida).

*Mikimyia furcifera* Bigot 1884: xxix. Holotype male (University Museum, Oxford), Type locality: Brazil [probably erroneous].

*Toxotrypana fairbatesi* Munro 1984: 160. Holotype male (South African National Collection of Insects). Type locality - Cuba: Soledad, Sta. Clara. Synonymy (Steyskal 1986: 114).

*Anastrepha littoralis* (Blanchard),  
**new combination**

*Toxotrypana littoralis* Blanchard 1960: 36. Holotype female (Museo Argentino de Ciencias Naturales). Type locality - Argentina: Corrientes: Corrientes. Distribution - Argentina, Guatemala, Peru (Cusco), Venezuela.

*Anastrepha nigra* (Blanchard),  
**new combination**

*Toxotrypana nigra* Blanchard 1960: 42. Holotype female (Museo Argentino

de Ciencias Naturales). Type locality - Argentina: Entre Ríos: Concordia. Distribution - Argentina (Córdoba, Entre Ríos, Jujuy, Santa Fe), Bolivia (Cochabamba).

*Toxotrypana pseudopicciola* Blanchard 1960: 43. Holotype female (Museo Argentino de Ciencias Naturales). Type locality - Argentina: Córdoba: Córdoba. Synonymy (Norrbom et al. 1999b: 338).

*Anastrepha nigrina* Norrbom,  
**new name**

*Anastrepha nigra* Norrbom and Korytkowski 2009: 37. Holotype female (National Museum of Natural History, Smithsonian Institution). Type locality - Panamá: Panamá: Parque Nacional Chagres, Altos de Pacora [9°15'28"N 79°21'24"W], Lote H4. Preoccupied by *nigra* Blanchard 1960: 42. Distribution - Panamá. Etymology - The name is a Latin adjective in reference to the dark wing pattern.

*Anastrepha picciola* (Blanchard),  
**new combination**

*Toxotrypana picciola* Blanchard 1960: 40. Holotype female (Museo Argentino de Ciencias Naturales). Type locality - Argentina: Tucumán: Estación Experimental Agrícola de Tucumán. Distribution - Argentina (Tucumán).

*Anastrepha proseni* (Blanchard),  
**new combination**

*Toxotrypana proseni* Blanchard 1960: 38. Holotype female (Museo Argentino de Ciencias Naturales). Type locality - Argentina: Buenos Aires: Punta Lara. Distribution - Argentina (Buenos Aires, Jujuy).

*Anastrepha recurcauda* (Tigrero),  
**new combination**

*Toxotrypana recurcauda* Tigrero 1992:  
 102. Holotype female (Pontificia  
 Universidad Católica del Ecuador).  
 Type locality - Ecuador: Loja: Mal-  
 acatos, Nangora, 79°6'W 04°13'S,  
 1,600 m. Additional description  
 and type data (Tigrero 1998: 6).  
 Distribution - Ecuador.

Generic Diagnosis for *Anastrepha*

The best diagnostic characters for *Anastrepha* as here recognized are genitalic, but most species can be recognized by their wing pattern and the other external characters listed below.

Body usually predominantly orange, occasionally predominantly brown or with brown markings, usually with white or yellow markings, although sometimes not well differentiated (typically including at least postpronotal lobe, post-sutural sublateral vitta on scutum, scutellum at least apically, dorsal margin of anepisternum, posterior margins of abdominal tergites, and often medial vitta on scutum).

*Thorax*: Dorsocentral seta aligned closer to postalar seta than to postsutural supra-alar seta or posterior to postalar seta, rarely absent (some species of *curvicauda* group).

*Wing*: Pattern usually consisting of C-, S- and V-bands variously connected or separated, occasionally instead with only uninterrupted costal band and cubital streak (wasp mimic pattern), rarely with other type of pattern (e.g., *A. apicata* Norrbom and Korytkowski, *A. obscura* Aldrich, male *A. lutea* Stone). Vein M<sub>1</sub> anteriorly curved on distal half of last segment (distal to crossvein dm-m), usually strongly curved apically and meeting costa without visible angle. Vein CuA with strong bend in middle

section, cell cua with large posteroapical lobe.

*Male terminalia*: Surstyli relatively short, lateral surstylus without anterior or posterior lobes (autapomorphy?). Subepandrial sclerite with strongly sclerotized secondary connection. Glans slender and weakly sclerotized medially, with T-shaped apical sclerite (autapomorphy), or absent (synapomorphy of *daciformis* and *dentata* groups).

*Female terminalia*: Oviscape with lateral, flange-like lobes basally (autapomorphy), tubular, often elongate, occasionally strongly dorsally arched. Eversible membrane enlarged basally and bearing group of enlarged dorsal denticles (autapomorphy; denticles secondarily reduced in *dentata* group, but still larger than in this area in most other tephritids, and the basal area still enlarged). Aculeus tip with 3 pairs of short sensilla ventrally, none extended beyond lateral margin; lateral margin serrate or entire.

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