

A REVIEW OF THE SUBGENUS *AUSTRODACUS* PERKINS OF *BACTROCERA* MACQUART (DIPTERA: TEPHRITIDAE: DACINAE)

D.L. HANCOCK¹ and R.A.I. DREW²

¹8/3 McPherson Close, Edge Hill, Cairns, Qld 4870

²International Centre for the Management of Pest Fruit Flies, Griffith University, Qld 4111

Abstract

The *Bactrocera* Macquart subgenus *Austrodacus* Perkins is reviewed and 5 species recorded from Australia and New Guinea are included: *B. abdoaurantiaca* Drew, *B. alampeta* Drew, *B. atrisetosa* (Perkins), *B. cucumis* (French) and *B. papuaensis* (Malloch), comb. n. (= *unichromata* Drew, syn. n.). Subgenus *Hemiparatriidacus* Drew is placed as a new synonym of subgenus *Austrodacus* and its sole species, *B. abdoaurantiaca*, is transferred, while *B. alampeta*, *B. atrisetosa* and *B. papuaensis* are transferred to *Austrodacus* from subgenus *Paratriidacus* Shiraki. A fourth Papua New Guinean species previously included in *Paratriidacus*, *B. mesonotaita* Drew, is transferred to subgenus *Zeugodacus* Hendel as a close ally of *B. (Z.) sandaricina* Drew.

Introduction

This is the third paper in a series reviewing the subgenera of the economically important fruit fly genus *Bactrocera* Macquart, made possible by the revisions of Australasian and Southeast Asian species by Drew (1989) and Drew and Romig (2013) respectively. Previous papers have reviewed the Indo-Australian subgenera *Calodacus* Hancock and *Parazeugodacus* Shiraki (Hancock 2015, Hancock and Drew 2015). This paper deals with subgenus *Austrodacus* Perkins, which is considered here to contain five described species known only from Indonesia's Papua Province, mainland Papua New Guinea and eastern and northern Australia. The recent elevation of the *Zeugodacus* group of subgenera to generic status (Virgilio *et al.* 2015, De Meyer *et al.* 2015) is not accepted here and we follow Drew and Romig (2013) and Hancock and Drew (2015) in retaining all species in genus *Bactrocera*. A preliminary statement of our reasons is given in Hancock and Drew (2015) and a comprehensive case is being prepared.

Genus *Bactrocera* Macquart

Subgenus *Austrodacus* Perkins

Austrodacus Perkins, 1937: 56. Type species *Dacus cucumis* French, 1907, by original designation.

Bactrocera (Hemiparatriidacus) Drew, 1989: 15. Type species *Bactrocera abdoaurantiaca* Drew, 1989, by original designation. **Syn. n.**

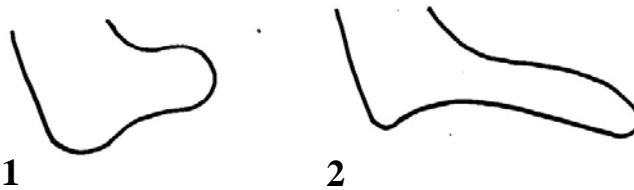
Definition. Abdominal sternite V of male with a shallow posterior emargination; posterior lobe of male surstylus narrow and elongate; pecten of cilia absent on abdominal tergite III of male; postpronotal setae absent; supralar setae present or absent; prescutellar acrostichal setae present or absent; two pairs of scutellar setae; scutum with medial postsutural yellow vitta present and lateral postsutural yellow vittae extending across suture anteriorly; wing with costal band narrow and not expanding apically; apex of aculeus very weakly trilobed [subapically 'keeled'].

Response to male lures. None known for any member of the subgenus. Single records of *B. alampeta* and ‘*B. unichromata*’ from methyl eugenol (Drew 1989) appear to be accidental and have not been repeated.

Included species. *B. (A.) abdoaurantiaca* Drew, *B. (A.) alampeta* Drew, *B. (A.) atrisetosa* (Perkins), *B. (A.) cucumis* (French) and *B. (A.) papuaensis* (Malloch) (= *B. unichromata* Drew, syn. n.).

Host plants. Recorded from the fruit of Cucurbitaceae and Solanaceae, with occasional records from other families (Drew 1989, Hancock *et al.* 2000).

Comments. The combination of a shallow emargination to sternite V and long posterior surstylus lobes place this subgenus in the *Zeugodacus* group of subgenera as defined by Drew (1989). Although three of the included species were included previously in subgenus *Paratridacus* Shiraki (*e.g.* by Drew 1989), that subgenus has the surstylus lobes shorter and much broader (Hardy 1974 and Fig. 1) than the narrow, elongate lobes seen in *Austrodacus*. *Paratridacus s.s.* also lacks a yellow medial vitta on the scutum, has non-cucurbitaceous host plants (*Garcinia* spp: Clusiaceae) and appears to be better placed in the *Melanodacus* group of subgenera, as suggested by Hancock and Drew (2015), with molecular evidence (Krosch *et al.* 2012) supporting this association. The weakly trilobed shape of the aculeus apex appears to be a synapomorphy for subgenus *Austrodacus*. Although the aculeus has not been examined in *B. abdoaurantiaca* or *B. alampeta* other characters, including the lack of a pecten on abdominal tergite III, very long posterior surstylus lobes (Fig. 2) and their overall appearance, suggest that they also belong in *Austrodacus*.



Figs 1-2. *Bactrocera* spp, male surstylus lobes: (1) *B. (Paratridacus) expandens* (Walker); (2) *B. (Austrodacus) abdoaurantiaca* Drew.

The only other *Zeugodacus*-group species known from the island of New Guinea or Australia that lacks a pecten of cilia on abdominal tergite III in males is *B. (Niuginidacus) singularis* Drew from Morobe Province, Papua New Guinea. However, that species has no lateral postsutural yellow vittae, only one pair of scutellar setae, a fuscous discal marking on the wing, an elongate-oval abdomen and males that respond to cue-lure. It is also smaller in size (wing length *ca* 5 mm) and, in lacking prescutellar acrostichal setae,

appears to be most closely related to several New Guinean species currently included in subgenus *Sinodacus* Zia.

Included species

For detailed morphological descriptions and illustrations see Drew (1989).

B. (Austrodacus) abdoaurantiaca Drew

Bactrocera (Hemiparatriidacus) abdoaurantiaca Drew, 1989: 188. Type locality Aiyura, Papua New Guinea.

Distribution. Eastern Highlands Province, Papua New Guinea.

Host plants. Unknown; swept from *Cucurbita* sp. (Cucurbitaceae) (1 ♂, Uni of Goroka gardens, Goroka, 24.vi.2011, A.D. Rice, in Department of Agriculture Collection, Cairns) and this is a likely host plant.

Comments. As noted above, the overall morphology of this species suggests a close relationship with other species of *Austrodacus* and the monotypic subgenus *Hemiparatriidacus* is thus regarded as a synonym. It differs from other *Austrodacus* species only in having the combination of supra-alar setae present and prescutellar acrostichal setae absent and appears closest to *B. alampeta*. The abdominal setulae are relatively short and white, with a weak gold reflection on tergites III-V. The above specimen from Goroka has fuscous abdominal markings as in *B. alampeta* and faint facial spots.

B. (Austrodacus) alampeta Drew

Bactrocera (Paratriidacus) alampeta Drew, 1989: 196. Type locality Mt Hagen, Papua New Guinea.

Bactrocera (Austrodacus) alampeta Drew: Hancock and Drew 2015: 101.

Distribution. Western Highlands Province, Papua New Guinea.

Host plants. Unknown.

Comments. This species appears closest to *B. abdoaurantiaca*, sharing with it a largely black scutum and differing primarily in the presence of both supra-alar and prescutellar acrostichal setae. The abdominal setulae are relatively short and white, with a weak gold reflection on tergites III-V.

B. (Austrodacus) atrisetosa (Perkins)

Zeugodacus atrisetosus Perkins, 1939: 29. Type locality Mondo, Papua New Guinea.

Dacus (Zeugodacus) cucumis: Malloch 1939: 412. Misidentification.

Melanodacus rubidus May, 1957: 297. Type locality Goroka, Papua New Guinea. Syn. May 1962: 64.

Melanodacus atrisetosus (Perkins): May 1962: 64.

Dacus (Paratriidacus) atrisetosus (Perkins): Drew 1973: 15.

Bactrocera (Paratriidacus) atrisetosa (Perkins): Drew 1989: 197.

Bactrocera (Austrodacus) atrisetosa (Perkins): Hancock and Drew, 2015: 101.

Types. Although Drew (1989) and Norrbom *et al.* (1999) referred only to syntype material for *B. atrisetosa*, Perkins (1939) stated: ‘Type returned to British Museum’, indicating designation of a single specimen as the holotype, but he did not state to which of the three listed specimens it referred. Two females from the type series are present in the Natural History Museum, London (BMNH: examined), labelled as follows:

HOLOTYPE ♀: Papua, Mondo, 5000’, ii.1934, L.E. Cheesman, BM 1934-321 / (red label) Holotype *Dacus atrisetosus* Perkins [in BMNH].

PARATYPE ♀: Papua, Mafulu, 4000’, i.1934, L.E. Cheesman, BM 1934-321 / (blue label) Paratype *Dacus atrisetosus* Perkins [in BMNH].

The action of Perkins in nominating a single ‘Type’ fulfils Section 73.1.1. of the International Code of Zoological Nomenclature (ICZN 1999) for original designation of a holotype and therefore we accept the above specimen so labelled as the holotype. Perkins’ third specimen, from Mt Lamington, Oro Province, although apparently seen by May (1962), has not been found in the collections of either the Queensland Museum [the current repository of Perkins’ retained specimens] or the Queensland Department of Agriculture and Fisheries [where May worked] (S. Wright and D. Tree pers. comms) and is presumed lost. Consequently, its identity has not been confirmed.

Distribution. Recorded from 1200-1650 m in Central, Oro, Morobe and Eastern Highlands Provinces in Papua New Guinea and Papua Province in Indonesia. Newly recorded from Vagau, Herzog Mts, *ca* 4000’, Morobe Province, Papua New Guinea, 9-17.i.1965 (7 ♂♀, in BMNH) and ‘Tanah Merah’ [above 1600 m] via Wamena, Papua Province, Indonesia, ‘3°51.95’S, 138°42.44’E’, 6.viii.1997, G. Bellis (1 ♀, in Department of Agriculture Collection, Cairns). A record from Queensland, Australia (Perkins and May 1949) is a misidentification of *B. (Hemizeugodacus) aglaiae* (Hardy). *Dacus papuaensis* Malloch, placed as a synonym of *B. atrisetosa* by May (1962), is regarded here as a separate species (see below).

Host plants. Recorded from *Citrullus lanatus*, *Cucumis melo*, *Cucumis sativus*, *Cucurbita pepo*, *Luffa cylindrica* and *Momordica charantia* (all Cucurbitaceae) and *Lycopersicon esculentum* (Solanaceae) (Drew 1989, Leblanc *et al.* 2012). The type specimens of ‘*M. rubidus*’ were collected on flowers of *Euphorbia pulcherrima* (Euphorbiaceae) (May 1957) but this is unlikely to be a host plant. Records from *Aglaia sapindina* (Meliaceae) (Drew 1989, Leblanc *et al.* 2012) are based on a misidentification of *B. aglaiae* from Queensland by Perkins and May (1949) before the latter species was described by Hardy (1951).

Comments. Although *B. atrisetosa* was referred to subgenus *Paratridacus* by Drew (1972, 1989), this was done solely on the presence of supra-alar and prescutellar acrostichal setae. However, its overall morphology clearly associates it with *B. cucumis* rather than with typical members of subgenus

Paratridacus, particularly the medial yellow vitta on the scutum and the shape of the male surstylus and female aculeus. The setulose and weakly trilobed ['keeled'] apex of the aculeus is very similar to that of *B. cucumis* (see Drew 1989, figs 335 and 357). The scutum and abdomen frequently have fuscous markings that vary in extent but unmarked specimens also occur. The abdominal setulae are long and white, with a gold reflection on tergites III-V. Malloch's (1939) female *B. cucumis* from Mondo, Papua New Guinea, is a misidentification of *B. atrisetosa* (specimen in BMNH: examined).

B. (Austrodacus) cucumis (French)

Dacus tryoni var. *cucumis* French, 1907: 307. Type locality Bowen, Queensland.

Dacus cucumis French: Froggatt 1910: 866.

Austrodacus cucumis (French): Perkins 1937: 56.

Dacus (Austrodacus) cucumis French: Hardy 1951: 122.

Bactrocera (Austrodacus) cucumis (French): Drew 1989: 185.

Distribution. Queensland (including Torres Strait islands), Northern Territory and northern New South Wales, Australia. A record from Mondo in Papua New Guinea (Malloch 1939) is a misidentification of *B. atrisetosa*.

Host plants. Recorded primarily from several species of Cucurbitaceae and Solanaceae (Drew 1989, Hancock *et al.* 2000). *Carica papaya* (Caricaceae) and *Passiflora* spp (Passifloraceae) are regarded as moderate hosts, while records from several other families appear to be incidental and in need of confirmation (Hancock *et al.* 2000).

Comments. This, the type species of *Austrodacus*, differs from all other species in the subgenus in lacking both supra-alar and prescutellar acrostichal setae. The costal cells are pale fulvous and the abdominal setulae are long and white with a gold reflection, as in *B. atrisetosa*; in these two species the silvery white pruinose areas apically on tergite II and laterally over the shining spots on tergite V are also more distinct than in all the other species (C. Lambkin pers. comm.). It is regarded as an economically important pest of cucurbits and tomatoes.

B. (Austrodacus) papuaensis (Malloch), **comb. n.**

Dacus (Zeugodacus) papuaensis Malloch, 1939: 412. Type locality Bulolo, Papua New Guinea.

Bactrocera (Paratridacus) unichromata Drew, 1989: 200. Type locality 20 km SE of Port Moresby, Papua New Guinea; **syn. n.**

Bactrocera (Austrodacus) unichromata Drew: Hancock and Drew 2015: 101.

Distribution. Below 1250 m in East Sepik, Morobe and Central Provinces, Papua New Guinea (Malloch 1939, Drew 1989); also in northeastern Papua Province, Indonesia (White and Evenhuis 1999). Additionally recorded from Moale Plantation, Wau, Morobe Province, 3800', xii.68-v.69, Mrs J.E.

Benson (1 ♀, in BMNH); Kapakapa [Gabagaba, coast *ca* 50 km SE of Port Moresby], Central Province, 1891, L. Loria (1 ♂, 1 ♀, in BMNH); and Laloki Research Station [*ca* 20 km E of Port Moresby], Central Province, 2.viii.2000, per D. Tenakanai, [reared] ex *Luffa cylindrica* (2 ♂♂, 9 ♀♀, in Department of Agriculture Collection, Cairns).

Host plants. Reared from *Luffa cylindrica* (Cucurbitaceae) [new record].

Comments. As with *B. atrisetosa*, the morphology of this species clearly associates it with *B. cucumis* rather than with typical members of subgenus *Paratridacus*, particularly the medial yellow vitta on the scutum, the weakly trilobed aculeus and the long posterior surstylus lobe (*ca* 1.5 times as long as width of surstylus; cf. *B. cucumis*: Hardy 1951, fig. 3a). Unlike *B. cucumis*, however, both supra-alar and prescutellar acrostichal setae are present. It most resembles pale forms of *B. atrisetosa*, differing in the denser, long yellow setulae on abdominal tergites III-V, pale third antennal segment and colourless costal cell c; it also occurs primarily at lower altitudes.

Although *B. papuaensis* was previously treated as a synonym of *B. atrisetosa* (e.g. May 1962, Drew 1989, Norrbom *et al.* 1999), this was based on presumed tenerality (May 1962). However, examined photographs of the [non-teneral] holotype male (in Australian Museum, Sydney) indicate a pale thorax without fuscous markings, a pale third antennal segment, colourless costal cells, dense and yellow abdominal setulae and a long, finger-like posterior surstylus lobe; the type specimens were also collected well below 1200 m. Hence, *B. papuaensis* is removed from the synonymy of *B. atrisetosa* and treated here as a senior synonym of *B. unichromata*, which agrees with it in all respects.

Excluded species

A further species referred to *Paratridacus* by Drew (1989), *B. mesonotaittha* Drew, is known only from the type female; hence the presence or absence of the pecten cannot be determined. However, the broader costal band (confluent with vein R₄₊₅) and more distinctly trilobed aculeus (see Drew 1989, figs 363 and 363A) closely resemble those of *B. (Zeugodacus) sandaricina* Drew, its potential sister-species; hence *B. mesonotaittha* is placed here in subgenus *Zeugodacus*, as indicated by Hancock and Drew (2015). The two species differ primarily in the width of the anepisternal stripe and both are known only from East Sepik Province, Papua New Guinea.

Key to *Austrodacus* species

- 1 Scutum black (with yellow lobes and vittae); anepisternal yellow stripe reaching line of anterior notopleural seta; facial spots faint or absent 2
- Scutum mostly or almost entirely red-brown or orange-brown, rarely extensively black; anepisternal yellow stripe not reaching line of anterior notopleural seta; facial spots present 3

- 2 Prescutellar acrostichal setae present; costal cells colourless
 *B. alampeta* Drew
- Prescutellar acrostichal setae absent; costal cells with a pale fuscous tint
 *B. abdoaurantiaca* Drew
- 3 Prescutellar acrostichal and supra-alar setae absent; scutum orange-brown
 without fuscous markings; anepisternal yellow stripe reaching almost to
 anterior notopleural seta *B. cucumis* (French)
- Prescutellar acrostichal and supra-alar setae present; scutum red-brown
 with or without fuscous markings; anepisternal yellow stripe reaching
 midway between anterior margin of notopleural callus and anterior
 notopleural seta 4
- 4 Abdominal tergites III-V with setulae distinctly yellow; third antennal
 segment entirely fulvous (extreme apex sometimes darker); scutum
 without black markings; costal cell c colourless
 *B. papuaensis* (Malloch)
- Abdominal tergites III-V with setulae white with a gold reflection; third
 antennal segment fuscous apically and on outer surface; scutum often
 with a pattern of black markings; costal cell c pale fulvous
 *B. atrisetosa* (Perkins)

Acknowledgements

We thank Sally Cowan (Department of Agriculture, Cairns) and Daniel Whitmore (Natural History Museum, London) for access to specimens, Dan Bickel, Russell Cox and John Martin (Australian Museum, Sydney) for photographs and information on the holotype of *B. papuaensis*, Christine Lambkin and Susan Wright (Queensland Museum, Brisbane) and Desley Tree (Queensland Department of Agriculture and Fisheries, Brisbane) for checking types and information on their collection holdings.

References

- DE MEYER, M., DELATTE, H., MWATAWALA, M., QUILICI, S., VAYASSIÈRES, J.-F. and VIRGILIO, M. 2015. A review of the current knowledge on *Zeugodacus cucurbitae* (Coquillett) (Diptera, Tephritidae) in Africa, with a list of species included in *Zeugodacus*. *ZooKeys* **540**: 539-557. [List of species provided as Supplementary material 1: 4 pp.]
- DREW, R.A.I. 1972. The generic and subgeneric classification of Dacini (Diptera: Tephritidae) from the South Pacific area. *Journal of the Australian Entomological Society* **11**: 1-22.
- DREW, R.A.I. 1973. Revised descriptions of species of Dacini (Diptera: Tephritidae) from the South Pacific area. I. Genus *Callantra* and the *Dacus* group of subgenera of genus *Dacus*. *Queensland Department of Primary Industries Division of Plant Industry Bulletin* **652**: 1-39.
- DREW, R.A.I. 1989. The tropical fruit flies (Diptera: Tephritidae: Dacinae) of the Australasian and Oceanian Regions. *Memoirs of the Queensland Museum* **26**: 1-521.
- DREW, R.A.I. and ROMIG, M.C. 2013. *Tropical fruit flies (Tephritidae: Dacinae) of South-East Asia*. CAB International, Wallingford; 653 pp.

- FRENCH, C. 1907. Fruit flies. *Journal of the Department of Agriculture, Victoria* 5: 301-312.
- FROGGATT, W.W. 1910. Notes on fruit flies (Trypetidae) with descriptions of new species. *Proceedings of the Linnean Society of New South Wales* 35: 862-872.
- HANCOCK, D.L. 2015. A new subgenus for six Indo-Australian species of *Bactrocera* Macquart (Diptera: Tephritidae: Dacinae) and subgeneric transfer of four other species. *Australian Entomologist* 42(1): 39-44.
- HANCOCK, D.L. and DREW, R.A.I. 2015. A review of the Indo-Australian subgenus *Parazeugodacus* Shiraki of *Bactrocera* Macquart (Diptera: Tephritidae: Dacinae). *Australian Entomologist* 42(2): 91-104.
- HANCOCK, D.L., HAMACEK, E.L., LLOYD, A.C. and ELSON-HARRIS, M.M. 2000. *The distribution and host plants of fruit flies (Diptera: Tephritidae) in Australia*. Information Series Q199067, Queensland Department of Primary Industries, Brisbane; iii + 75 pp.
- HARDY, D.E. 1951. The Krauss collection of Australian fruit flies (Tephritidae–Diptera). *Pacific Science* 5: 115-189.
- ICZN (International Commission on Zoological Nomenclature). 1999. *International code of zoological nomenclature*. 4th edition. International Trust for Zoological Nomenclature, London; 306 pp.
- KROSCHE, M.N., SCHUTZE, M.K., ARMSTRONG, K.F., GRAHAM, G.C., YEATES, D.K. and CLARKE, A.C. 2012. A molecular phylogeny for the tribe Dacini (Diptera: Tephritidae): systematic and biogeographical implications. *Molecular Phylogeny and Evolution* 64: 513-523.
- LEBLANC, L., TORA VUETI, E., DREW, R.A.I. and ALWOOD, A.J. 2012. Host plant records for fruit flies (Diptera: Tephritidae: Dacini) in the Pacific Islands. *Proceedings of the Hawaiian Entomological Society* 44: 11-53.
- MALLOCH, J.R. 1939. The Diptera of the Territory of New Guinea. XI. Family Trypetidae. *Proceedings of the Linnean Society of New South Wales* 64: 409-465.
- MAY, A.W.S. 1957. New species and records of Dacinae (Trypetidae, Diptera) from Queensland and New Guinea. *Queensland Journal of Agricultural Science* 14: 293-306.
- MAY, A.W.S. 1962. Additions to the species of Dacinae (Trypetidae, Diptera) from Queensland and New Guinea. *Queensland Journal of Agricultural Science* 19: 63-76.
- NORRBOM, A.L., CARROLL, L.E., THOMPSON, F.C., WHITE, I.M. and FREIDBERG, A. 1999. Systematic database of names. Pp 65-251, in: Thompson, F.C. (ed.), Fruit fly expert identification system and systematic information database. *Myia* 9: ix + 524 pp.
- PERKINS, F.A. 1937. Studies in Australian and Oriental Trypanidae. Part 1. New genera of Dacinae. *Proceedings of the Royal Society of Queensland* 48(9): 51-60.
- PERKINS, F.A. 1939. Studies in Australian and Oriental Trypetidae. Part 3. *Papers of the University of Queensland Department of Biology* 1(10): 1-35.
- PERKINS, F.A. and MAY, A. 1949. Studies in Australian and Oriental Trypetidae. Part IV. New species of Dacinae from Queensland. *Papers of the University of Queensland Department of Biology* 2(14): 1-21.
- VIRGILIO, M., JORDAENS, K., VERWIMP, C., WHITE, I.M. and DE MEYER, M. 2015. Higher phylogeny of frugivorous flies (Diptera: Tephritidae: Dacini): localised partition conflicts and a novel generic classification. *Molecular Phylogenetics and Evolution* 85: 171-179.
- WHITE, I.M. and EVENHUIS, N.L. 1999. New species and records of Indo-Australian Dacini (Diptera: Tephritidae). *Raffles Bulletin of Zoology* 47: 487-540.