EPPO Datasheet: *Bactrocera minax*

Last updated: 2020-09-23

IDENTITY

Preferred name: *Bactrocera minax*
Authority: (Enderlein)
Taxonomic position: Animalia: Arthropoda: Hexapoda: Insecta: Diptera: Tephritidae
Other scientific names: *Bactrocera citri* (Chen), *Callantra minax* (Enderlein), *Dacus citri* (Chen), *Mellesis citri* Chen, *Polistomimetes minax* Enderlein, *Tetradacus citri* (Chen)
Common names: Chinese citrus fly
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EPPO Categorization: A1 list
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EPPO Code: DACUCT

Notes on taxonomy and nomenclature

Bactrocera minax belongs to the subgenus *Tetradacus*, within the genus *Bactrocera*. As such it can be referred to in the literature as *Bactrocera (Tetradacus) minax*. A recent review of, and identification key to all species of the subgenus *Tetradacus* is given by Hancock & Drew (2019).

B. minax has erroneously been considered synonymous with *B. tsuneonis* (EPPO/CABI, 1996).

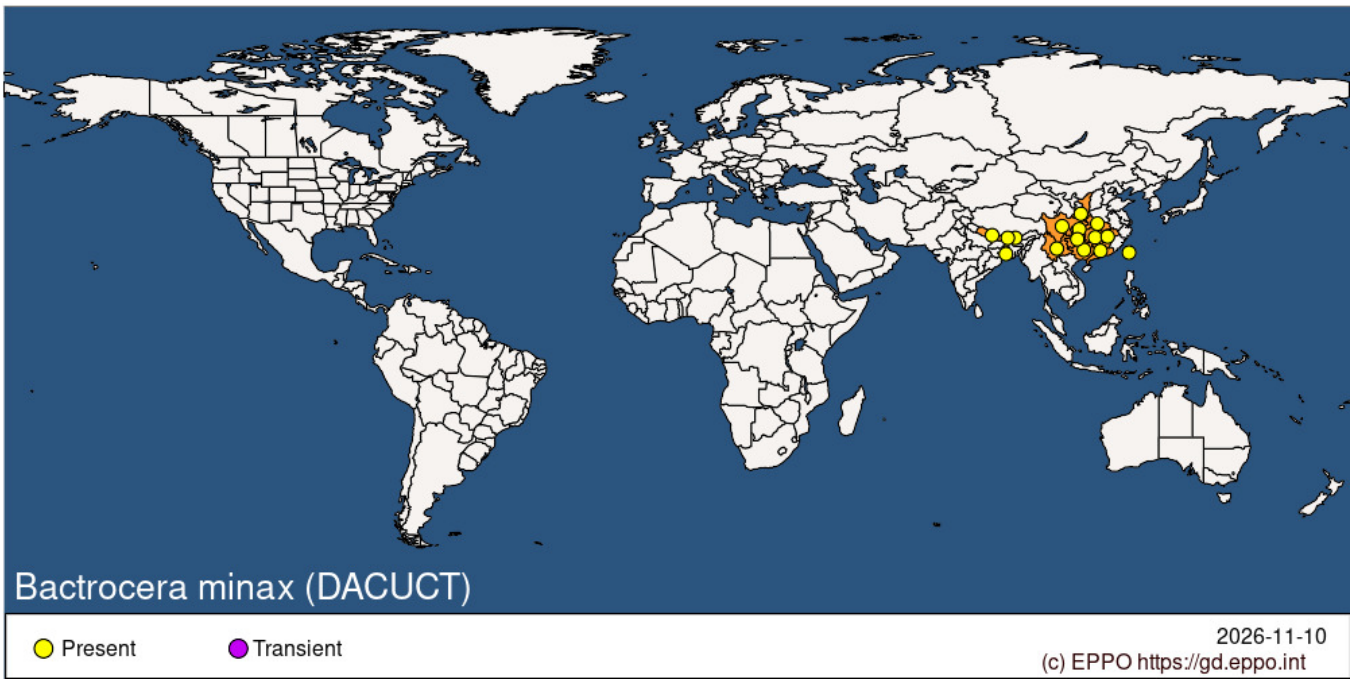
HOSTS

B. minax is found exclusively on Rutaceae, such as *Citrus* and *Fortunella*. Xia *et al.* (2018) reports that in China most surveys indicate that mainly sweet oranges are heavily infested, although some surveys have shown high infestation occasionally in pomelo and sour oranges. In Bhutan mandarins are heavily infested (Dorji *et al.*, 2006). The USDA Compendium of Fruit Fly Host Information (CoFFHI) (Chang *et al.*, 2018) provides an extensive host list with detailed references.

Host list: *Citrus maxima*, *Citrus medica*, *Citrus reticulata*, *Citrus trifoliata*, *Citrus x aurantiifolia*, *Citrus x aurantium var. deliciosa*, *Citrus x aurantium var. paradisi*, *Citrus x aurantium var. sinensis*, *Citrus x aurantium var. tangerina*, *Citrus x aurantium var. unshiu*, *Citrus x aurantium*, *Citrus x junos*, *Citrus x limon*, *Citrus x nobilis*, *Fortunella crassifolia*, *Fortunella japonica*, *Fortunella margarita*

GEOGRAPHICAL DISTRIBUTION

The known distribution of *B. minax* is restricted to northeastern India, Bhutan, Nepal, and southern China. The record from Donghai County in Jiangsu, China is uncertain according to Hancock & Drew (2018).



Asia: Bhutan, China (Chongqing, Guangdong, Guangxi, Guizhou, Hubei, Hunan, Jiangxi, Shaanxi, Sichuan, Yunnan), India (Sikkim, West Bengal), Nepal, Taiwan

BIOLOGY

Bactrocera minax is an univoltine species (only one generation each year) and goes into diapause in the soil as a pupa during winter (Dong *et al.*, 2013). The overwintering stage lasts about 160-170 days (Fan *et al.*, 1994) and a period of at least three months of winter conditions is required for successful diapause development and termination (Dong *et al.*, 2013). Diapause termination is synchronized with fruit development, with adult emergence between April and May and adult life span between one and three months (Xia *et al.*, 2018). Oviposition takes place in June-July (Dorji *et al.*, 2006), and eggs are laid below the skin of young host fruits. Three larval stages develop inside the fruit, feeding on the plant tissue. A review on this species in China is given by Xia *et al.* (2018), while details of development in mandarin in Bhutan is given by Dorji *et al.* (2006). Additional information is given in Zhang (1989), Fan *et al.* (1994), and Dong *et al.* (2013). In general, *B. minax* has a similar biology to *B. tsuneonis* but adults of *B. tsuneonis* can be found over a longer time in the field.

DETECTION AND IDENTIFICATION

Symptoms

Attacked fruit have tiny oviposition punctures, but these and other symptoms of damage are often difficult to detect in the early stages of infestation. Considerable damage may occur inside the fruit before symptoms are visible externally, often as networks of tunnels accompanied by rotting.

Morphology

Larva

Fruit fly larvae in general have a typical shape, i.e., cylindrical maggot-shape, elongate, anterior end narrowed and somewhat recurved ventrally, with anterior mouth hooks, and flattened caudal end. Their length varies from 5 to 15 mm. Identification to species level is not possible based on larvae. A key for the 3rd-instar larvae is available in White & Elson- Harris (1992) and is useful for an identification to the genus level. The larva of *B. minax* is also described in some detail by White & Elson-Harris (1992).

Adult

Redescription, as given by Drew & Romig (2013).

Male

Head. Red-brown, fulvous along eye margins and with small dark fuscous areas around bases of orbital setae and on anteromedial hump; orbital setae black: 1 superior, 2 inferior; lunule dark fuscous. Ocellar triangle black. Vertex red-brown. Face fulvous with a pair of large elongate black spots filling most of antennal furrow. Occiput red-brown, fulvous along eye margins; occipital row with 1-4 weak black setae. Antennae with all segments red-brown.

Thorax. Scutum red-brown with a mottled appearance from dorsoventral flight muscles and irregular dark fuscous patterns and particularly with a narrow medial longitudinal dark fuscous line running from anterior point of medial postsutural yellow vitta to anterior margin of scutum. Pleural areas red-brown with fuscous along anterior and posterior margins of mesopleural stripe. Yellow markings as follows: postpronotal lobes; notopleura; a lateral yellow band running from posterior margin of postpronotal lobes towards notopleuron but finishing before the notopleuron; a broad mesopleural stripe reaching the anterior notopleural seta dorsally, extending to the katepisternum as a large transverse spot, anterior margin slightly convex; anatergite (posterior apex red-brown); anterior two-thirds katatergite (remainder red-brown); two medium-width parallel-sided lateral postsutural vittae ending at intra-alar seta and turned slightly inwards along notopleural suture; a broad medial postsutural vitta broadly rounded posteriorly at level of posterior supraalar. seta and narrowing to a point to end anteriorly before level of notopleural suture. Postnotum red-brown. Scutellum yellow except for narrow red-brown basal band. Setae: 2 scutellar, 1 intra-alar, 1 posterior supra-alar, 1 mesopleural, 1 notopleural, 2 scapular; prescutellar and anterior supra-alar absent.

Legs. Femora fulvous except for small areas of fuscous around bases of all femora and larger areas of fuscous to dark fuscous around apices of mid and hind femora ; fore tibiae fuscous to dark fuscous basally to fulvous apically, hind tibiae fuscous to dark fuscous; all tarsal segments fulvous; mid tibiae each with an apical black spur.

Wings. Length 10.8 mm; cells bc and c fuscous; microtrichia in outer half of cell c only; remainder of wings colourless except fuscous cell sc, broad fuscous costal band overlapping R4+5 and having a distinct dark fuscous spot within apex, a distinct anal streak absent but with pale fuscous within cell cup; no dense aggregation of microtrichia around A1+CuA2; supernumerary lobe weak.

Abdomen. Elongate oval and petiolate; terga free; pecten present on tergum III. Tergum I and sterna I and II longer than wide. Terga I and II fulvous with narrow fuscous to dark fuscous lateral margins and a broad medial longitudinal dark fuscous band that is diffuse on the lateral margins; terga III-V variable from fulvous to red-brown and with a dark fuscous to black ‘T’ pattern consisting of a broad transverse band across anterior margin of tergum III which widens to cover lateral margins and a narrow medial longitudinal band over all three terga but ending before posterior margin of tergum III, fuscous to dark fuscous anterolateral corners on terga IV and V (in some specimens the dark patterns on terga III-V are paler and reduced to a fuscous medial longitudinal band over all three terga and pale fuscous anterolateral corners on terga IV and V). A pair of oval fulvous to red-brown shining spots on tergum V. Posterior lobe of surstylus short, sternum V with a slight concavity on posterior margin. Abdominal sterna variable from red-brown to fuscous.

Female

As for male except pecten of cilia on abdominal tergum III absent, ovipositor basal segment red-brown, broadly conical in transverse cross section at base and narrowing and circular in transverse cross section towards apex, and extremely long; ratio of length of oviscape to length of tergum V, 2.7:1; apex of piercer needle-shaped.

B. minax is morphologically similar to *B. tsuneonis* (Drew & Romig, 2013), but lacking anterior supra-alar setae. It has an incomplete lateral yellow band between the postpronotal lobe and the notopleuron and the female has a longer ovipositor (aculeus 3.7-5.0 mm long), with a needle-shaped apex. Full details of the separation of these species were given by White & Wang (1992) and Drew & Romig (2013). Hancock & Drew (2019) provide an identification key for all representatives of the subgenus *Tetradacus*.

DNA barcoding

In the Barcode of Life Data Systems (BOLD), *B. minax* only forms monospecific Barcoding Index Number Systems (BINs) including representatives from the geographical distribution of this species. For this reason, DNA barcoding might be considered as a suitable tool for the molecular identification of this species. Sequences are available in the Barcode of Life Data Systems (**BOLD**) and in **EPPO-Q-Bank**.

Detection and inspection methods

Though most *Bactrocera* spp. can be monitored by traps baited with male lures, *B. minax* is not known to be attracted to any male lure. A weak attraction of both sexes to methyl eugenol was reported by Drew *et al.* (2007). However, this appears to be a seasonal effect, related to the fly's sexual maturation and mating (Royer, 2015) and considered incidental by Hancock & Drew (2018). Both sexes can be monitored by traps baited with protein-based attractants (Xia *et al.*, 2018). Chen *et al.* (2017) report the use of fruit mimic traps as effective in monitoring of *B. minax*. Detection is also possible by examination of fruit for oviposition punctures and then rearing the larvae through to the adult stage.

PATHWAYS FOR MOVEMENT

Transport of infested fruits is the main mean of movement and dispersal to previously uninfested areas. Adult flight can also result in dispersal but previous citations of long (50-100 km) dispersal movements for *Bactrocera* spp. are unsubstantiated according to a recent review by Hicks *et al.* (2019). Dispersal up to 2 km is considered more typical.

PEST SIGNIFICANCE

Economic impact

B. minax is stenophagous, only attacking citrus fruits. It is a serious pest of citrus in parts of China (Zhang, 1989) but the severity and economic impact can differ among the different regions (Xia *et al.*, 2018).

Control

Management for this species includes the general control measures for *Bactrocera* spp. (see Vargas *et al.* 2015 for an overview of management options). Specific Integrated Pest Management (IPM) and other management options applied in Bhutan and China are reviewed respectively in Dorji *et al.* (2006) and Xia *et al.* (2018). These include sanitation (to gather all fallen and infested host fruits, and destroy them), and raking or shallow plowing of the soil during winter (to expose the pupae). Insecticidal protection is possible by using a cover spray or a bait spray. Bait sprays work on the principle that both male and female tephritids are strongly attracted to a protein source from which ammonia emanates. Bait sprays have the advantage over cover sprays in that they can be applied as a spot treatment so that the flies are attracted to the insecticide and there is minimal impact on natural enemies and beneficials. Xia *et al.* (2018) give a review of comparative testing of different food-based lures against *B. minax*. Area-wide control, using protein bait spraying, was recently conducted in Nepal (Adhikari *et al.*, 2020). Wang & Luo (1995) report the use of Sterile Insect Technique (SIT) on orange crops in Guizhou Province, China in 1993 and 1994 resulting in a reduction from over 5% infestation to about 0.1% by releasing 1 million sterile males (obtained from natural populations). For more details on this and other SIT applications in China, see Xia *et al.* (2018). The main current drawback for mass rearing of *B. minax* for SIT is the obligatory diapause.

Phytosanitary risk

Citrus species are important crops in the EPPO region. *B. minax* is a known pest of *Citrus* in the area where it is present. It can be moved in trade with infested fruit. Although no detailed study was made on climatic suitability of the EPPO region for this species, *B. minax* is known to occur in temperate areas. Transient populations could also have negative impacts on export of host fruit from the EPPO region. The EFSA Panel on Plant Health, in their Pest Categorization of non-EU Tephritidae (Bragard *et al.* 2020) placed *B. minax* on the list of fruit flies that satisfy the criteria to be regarded as a potential Union quarantine pest for the EU.

PHYTOSANITARY MEASURES

Consignments of fruits of *Citrus* and *Fortunella* from countries where *B. minax* occurs should be inspected for symptoms of infestation and those suspected should be cut open in order to look for larvae. Possible measures include that such fruits should come from an area where *B. minax* does not occur, or from a place of production found free from the pest by regular inspections in the 3 months before harvest.

In China both irradiation and cold treatment have been explored as phytosanitary measures. Irradiation required 50-90 Gy to reach zero adult emergence (Gao *et al.*, 1999; Zhao *et al.*, 1995). No specific treatment schedules for cold treatment have been developed but given the cold tolerance of *B. minax* it is uncertain if schedules for other fruit flies (such as *Ceratitis capitata*) will be adequate.

Plants of citrus transported with roots from countries where *B. minax* occurs should be free from soil, or the soil should be treated against puparia. The plants should not be bearing fruits. Citrus plants are in any case prohibited from importation in many countries because of other quarantine pests.

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CABI resources used when preparing this datasheet

CABI invasive species compendium: https://www.cabi.org/isc/datasheet/8726

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Datasheet history

This datasheet was first published in 1992 in 'Quarantine Pests for Europe' as *Bactrocera* spp. (non-European), then as '*Bactrocera minax*' in the second edition of the book in 1997, and revised in 2020. It is now maintained in an electronic format in the EPPO Global Database. The sections on 'Identity', 'Hosts', and 'Geographical distribution' are automatically updated from the database. For other sections, the date of last revision is indicated on the right.

CABI/EPPO (1992/1997) *Quarantine Pests for Europe (1st and 2nd edition)*. CABI, Wallingford (GB).



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