Data Sheets on Quarantine Pests

Bactrocera dorsalis

IDENTITY

Name: *Bactrocera dorsalis* (Hendel)
Synonyms: *Chaetodacus ferrugineus* (Fabricius)
Chaetodacus ferrugineus dorsalis (Hendel)
Chaetodacus ferrugineus var. *okinawanus* Shiraki
Dacus dorsalis Hendel
Strumeta dorsalis (Hendel)
Taxonomic position: Insecta: Diptera: Tephritidae
Common names: Oriental fruit fly (English)
Mouche orientale des arbres fruitiers, Mouche des fruits asiatique (French)
Orientalische Fruchtfliege (German)
Mosca oriental das frutas (Portuguese)
Notes on taxonomy and nomenclature: *B. dorsalis* forms part of a species complex, within which over 50 species have been described in Asia. Many earlier records of *B. dorsalis* from southern India, Indonesia, Malaysia, Philippines and Sri Lanka are based on misidentifications of what are now (Drew & Hancock, 1994) known to be other species. Seven of these species are also recognized to be pests of cultivated plants. Because most of these have only recently been described, their status as quarantine pests for Europe remains to be fully assessed. Basic details on them are accordingly given in this data sheet. Earlier quarantine concerns about *B. dorsalis* referred in part to these other species.
Bayer computer code: DACUDO
EPPO A1 list: No. 233
EU Annex designation: I/A1 - as *Dacus dorsalis*

- ***Bactrocera carambolae***
  Name: *Bactrocera carambolae* Drew & Hancock
  Synonyms: *Bactrocera* sp. A
  Common names: Carambola fruit fly (English)
  Bayer computer code: BCTRCB
- ***Bactrocera caryeae***
  Name: *Bactrocera caryeae* (Kapoor)
  Synonyms: *Dacus caryeae* Kapoor
  Bayer computer code: BCTRCR
- ***Bactrocera kandiensis***
  Name: *Bactrocera kandiensis* Drew & Hancock
  Synonyms: *Bactrocera* sp. D
  Bayer computer code: BCTRKA
- ***Bactrocera occipitalis***
  Name: *Bactrocera occipitalis* (Bezzi)

Synonyms: *Chaetodacus ferrugineus* var. *occipitalis* Bezzi
Dacus occipitalis (Bezzi)
Bayer computer code: BCTROC

- ***Bactrocera papayae***
Name: *Bactrocera papayae* Drew & Hancock
Synonyms: *Bactrocera* sp. B
Bayer computer code: BCTRPW
- ***Bactrocera philippinensis***
Name: *Bactrocera philippinensis* Drew & Hancock
Synonyms: *Bactrocera* sp. C
Bayer computer code: BCTRPH
- ***Bactrocera pyrifoliae***
Name: *Bactrocera pyrifoliae* Drew & Hancock
Bayer computer code: BCTRPY

HOSTS

B. dorsalis occurs on a wide range of fruit crops, for example in China and Japan on *Annona squamosa*, apples (*Malus pumila*), *Averrhoa carambola*, bananas (*Musa paradisiaca*), *Capsicum*, *Clausena lansium*, guavas (*Psidium guajava*), mangoes (*Mangifera indica*), oranges (*Citrus sinensis*), pawpaws (*Carica papaya*), peaches (*Prunus persica*), plums (*Prunus domestica*), *Pyrus* spp. and tomatoes (*Lycopersicon esculentum*) (Clausen *et al*., 1965; Koyama, 1989). Due to confusion between *B. dorsalis* and related species in South East Asia, some published host data may concern other species within the *B. dorsalis* species complex. On the other hand, the published host ranges of the newly described species (Drew & Hancock, 1994) are probably incomplete. They have mostly been found on hosts such as mangoes, guavas and pawpaws, and in general seem likely to be polyphagous like *B. dorsalis*. *B. carambolae* occurs especially on *A. carambola* and *Syzygium samarangense* in South America. The wild hosts of *B. dorsalis* and its sister species are not well documented. In the EPPO region, numerous fruit crops are potential hosts.

GEOGRAPHICAL DISTRIBUTION

- ***Bactrocera dorsalis***
B. dorsalis as now described occurs in the northern part of the range of the *dorsalis* complex in Asia, exclusively in the Northern Hemisphere (with the marginal exception of Nauru). The other species occur in the south of the Indian subcontinent and in South East Asia.
EPPO region: Absent.
Asia: Bangladesh, Bhutan, Cambodia, China (southern: Fujian, Guangdong, Guangxi, Guizhou, Hainan, Hunan, Sichuan, Yunnan), Hong Kong, India (mainly northern: Assam, Bihar, Delhi, Haryana, Jammu and Kashmir, Karnataka, Maharashtra, Manipur, Orissa, Punjab, Rajasthan, Sikkim, Tamil Nadu, Uttar Pradesh, West Bengal), Japan (Ryukyu Archipelago, eradicated in 1985), Lao, Myanmar, Nepal, Pakistan, Sri Lanka, Taiwan, Thailand (northern), United Arab Emirates, Viet Nam.
North America: Outbreaks in USA (California, Florida), eradicated (FAO, 1987) but found again in California in 1989. Reported in Hawaii since about 1945.
Oceania: Guam since 1947, Nauru. An outbreak on Northern Mariana Islands (Rota) was eradicated (Nakagawa *et al*., 1968).
EU: Absent.

Distribution map: See IIE (1994a, No. 109). IIE (1994b, No. 553) also gives a composite picture of the distribution of the *B. dorsalis* complex in general.

- ***Bactrocera carambolae***
  EPPO region: Absent.
  Asia: Brunei Darussalam, India (Andaman Islands), Indonesia (Java, Nusa Tenggara), Malaysia (Peninsular, Sabah), Singapore, Thailand (southern).
  South America: introduced into French Guiana, Guyana and Suriname.
  EU: Absent.
  Distribution map: See IIE (1994c, No. 546).
- ***Bactrocera caryeae***
  EPPO region: Absent.
  Asia: India (Karnataka, Tamil Nadu), Oman (intercepted only), Sri Lanka.
  EU: Absent.
  Distribution map: See IIE (1994d, No. 550).
- ***Bactrocera kandiensis***
  EPPO region: Absent.
  Asia: Sri Lanka.
  EU: Absent.
  Distribution map: See IIE (1994e, No. 551)
- ***Bactrocera occipitalis***
  EPPO region: Absent.
  Asia: Brunei Darussalam, Malaysia (Peninsular, Sabah), Philippines, Taiwan (possible misidentification).
  EU: Absent.
  Distribution map: See IIE (1994f, No. 549)
- ***Bactrocera papayae***
  EPPO region: Absent.
  Asia: Brunei Darussalam, Christmas Island, Indonesia (Irian Jaya, Java, Kalimantan, Nusa Tenggara, Sulawesi), Malaysia (Peninsular, Sabah), Singapore, Thailand (southern).
  Oceania: Australia (Queensland - Torres Straits islands and Cairns areas), Papua New Guinea.
  EU: Absent.
  Distribution map: See IIE (1994g, No. 547).
- ***Bactrocera philippinensis***
  EPPO region: Absent.
  Asia: Philippines.
  EU: Absent.
  Distribution map: See IIE (1994h, No. 548).
- ***Bactrocera pyrifoliae***
  EPPO region: Absent.
  Asia: Thailand.
  EU: Absent.
  Distribution map: See IIE (1994i, No. 552).

BIOLOGY

Eggs of *B. dorsalis* are laid below the skin of the host fruit. These hatch within 1-3 days and the larvae feed for another 9-35 days. *B. dorsalis* will not develop at temperatures below 13°C. Pupariation is in the soil under the host plant and adults emerge after 1-2 weeks (longer in cool conditions) and adults occur throughout the year (Christenson &

Foote, 1960). *B. dorsalis* is a tropical species which would be unable to survive the winter in the EPPO region, except possibly in the south. The adults are best able to survive low temperatures, with a normal torpor threshold of 7°C, dropping as low as 2°C in winter. Though little is specifically known about the biology of the other pest species of the *B. dorsalis* complex, there is no reason to suppose that it differs greatly from that of *B. dorsalis*; if anything, they could be supposed from their distribution to be even more specifically adapted to tropical conditions.

DETECTION AND IDENTIFICATION

Symptoms

Attacked fruit will usually show signs of oviposition punctures. Fruit with a high sugar content, such as peaches, will exude a sugary liquid, which usually solidifies adjacent to the oviposition site.

Morphology

The description applies to *B. dorsalis* or any other member of the complex. See Drew & Hancock (1994) for detailed descriptions, and keys, of the other species; identification should in any case be referred to a specialist. Recently, DNA probes have been proposed as a practical means of discriminating between all life stages of the three main tephritids present in Hawaii (*C. capitata*, *Bactrocera cucurbitae* and *B. dorsalis*) (Haymer *et al*., 1994).

Larva

Described by White & Elson-Harris (1992). Other larval descriptions labelled as *B. dorsalis* may be based on misidentifications.

Adult

Colour: Face marked with a dark spot in each antennal furrow; scutum predominantly black, except for lateral yellow vittae, and yellow postpronotal lobe and notopleurae; scutellum entirely pale-coloured, except sometimes for a narrow black line across the base; costal margin of wing with a distinct coloured band from the end of vein Sc to just beyond the end of vein R4+5; crossveins r-m and dm-cu not covered by any markings; abdominal tergites three to five with a distinct black 'T'-shaped mark; postpronotal lobes without any setae (sometimes with some small setulae or hairs). Head: With reduced chaetotaxy, lacking ocellar and postocellar setae; first flagellomere at least three times as long as broad. Thorax: With reduced chaetotaxy, lacking dorsocentral and katepisternal setae. Scutum with anterior supra-alar setae and prescutellar acrostichal setae; scutellum not bilobed, with only two marginal setae (the apical pair). Wing: Vein Sc abruptly bent forward at nearly 90°, weakened beyond this bend and ending at subcostal break; vein R1 with dorsal setulae; cell cup very narrow, about half depth of cell bm; cup extension very long, equal or longer than length of vein A1+CuA2. 5-7 mm long. Cell bc and basal half of cell c without a complete covering of microtrichia. Abdomen: All tergites separate (view from side to see overlapping sclerites); tergite five with a pair of slightly depressed areas (ceromata). Male with a row of setae (the pecten) on each side of tergite three.

Detection and inspection methods

B. dorsalis and other species listed here can be monitored by traps baited with male lures. Methyl eugenol (O-methyl eugenol) attracts *B. dorsalis* and the other species listed here (except probably *B. pyrifoliae*) at very low concentrations and is believed to attract over a range of up to 1 km. The lure is usually placed on a cotton-wool wick suspended in the middle of a plastic trap that has small openings at both ends; Drew (1982) describes the Steiner trap. Lure can either be mixed with an insecticide (malathion or dichlorvos) or a piece of paper dipped in dichlorvos can be placed in the trap. Traps are usually placed in

fruit trees at a height of about 2 m above ground and should be emptied regularly as it is possible to catch hundreds of flies in a single trap left for just a few days, although the lure may remain effective for at least 2 weeks. A review of the biological aspects of male lures was presented by Cunningham (1989a) and the use of lures is described more fully by Drew (1982). A trapping system used to monitor for possible introductions of *B. dorsalis* into New Zealand has been described by Somerfield (1989).

MEANS OF MOVEMENT AND DISPERSAL

Adult flight and the transport of infested fruits are the main means of movement and dispersal to previously uninfested areas. Okawa (1993) lists the numerous fruit species on which *B. dorsalis sensu lato* was intercepted in Japan in the 1980s. *B. dorsalis sensu lato* was by far the most frequently intercepted tephritid (80%) on prohibited fruit in a study at Osaka Airport, Japan (Matsumoto *et al*., 1992). Many *Bactrocera* spp. can fly 50-100 km (Fletcher, 1989). Some host fruits are only infested when ripe, and this has been the basis for an "infestation-free quarantine procedure" for avocados exported from Hawaii to mainland USA, which was recently called into question when fruits still on the tree were found to be infested (Liquido *et al*., 1995).

PEST SIGNIFICANCE

Economic impact

B. dorsalis is a serious pest of a wide variety of unrelated fruit crops, but seldom cucurbits. Waterhouse (1993) identifies it as one of the five most important pests of agriculture in South East Asia. Published data on its importance applies over all the Asian range of the *B. dorsalis* complex, including areas where *B. dorsalis* is not now considered to occur. On this basis, at least the more widely distributed of the other pest species of the complex (*B. carambolae*, *B. papayae*) are probably as damaging. It should be noted, however, that Drew & Hancock (1994) attribute pest status to the group of species mentioned in this data sheet without specific supporting information. I.M. White (pers. comm.) reports that these two species and *B. occipitalis*, *B. philippinensis* and *B. kandiensis* are as damaging as *B. dorsalis*, while *B. caryeae* is probably as damaging and *B. pyrifoliae* is only a pest in a very limited area.

Control

When detected, it is important to gather all fallen and infested host fruits, and destroy them (Liquido, 1993). Those species whose males are attracted to lures should be continually monitored using bait traps (Bateman, 1982). Insecticidal protection is possible by using a cover spray or a bait spray. Malathion is the usual choice of insecticide for fruit fly control and this is usually combined with protein hydrolysate to form a bait spray (Roessler, 1989); practical details are given by Bateman (1982). 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. Biological control has been tried against *B. dorsalis sensu lato*, but introduced parasitoids have had little impact (Wharton, 1989). Male annihilation, utilizing the attraction of males to methyl eugenol was used to eradicate *B. dorsalis* from the northern Ryukyu Islands, Japan (Cunningham, 1989b). The sterile insect technique (SIT), requiring the release of millions of sterile flies into the wild population so that there is a strong likelihood of wild females mating with sterile males (Gilmore, 1989), was used to eradicate *B. dorsalis* from the Ogasawara Islands, Japan (Shiga, 1989).

Phytosanitary risk

EPPO lists *B. dorsalis* as an A1 quarantine pest (OEPP/EPPO, 1983) within the broad category "non-European Trypetidae"; it is also of quarantine significance to APPPC, COSAVE, CPPC, IAPSC, JUNAC and OIRSA. *B. dorsalis* is indigenous to Asia, but like other *Bactrocera* spp. is known by experience to have the potential to establish adventive populations in various other tropical areas. Its presence in Hawaii, but not in mainland USA, has contributed to its high international profile as a quarantine pest. Occurring in northern India and in parts of central China, *B. dorsalis* has a geographical range which is less tropical than the other members of the complex. The direct risk of establishment of *B. dorsalis* in most of the EPPO region is minimal, though populations might enter and multiply during the summer months. In southern areas, such populations could possibly survive one or several winters; it is difficult to judge how directly damaging they might be. The major risk for EPPO countries arises from the probable imposition of much stricter phytosanitary restrictions on exported fruits (particularly to America) if *B. dorsalis* enters and multiplies, even temporarily.

The other species mentioned in this data sheet are more tropical in their distribution, and are of less certain pest status. In general, their status as quarantine pests is difficult to establish in the absence of a sufficient opportunity for their pest status to be documented. Certain of them (*B. caryeae*, *B. kandiensis*, *B. pyrifoliae*) do not, on currently available information, appear to be abundant and widely distributed pests of cultivated plants. Since in addition other more important *Bactrocera* spp. occur in the countries concerned, EPPO would not normally have any particular reason to mention them as quarantine pests.

PHYTOSANITARY MEASURES

Consignments of fruits of especially *Annona*, *Averrhoa carambola*, *Citrus*, *Fortunella*, *Malus*, *Mangifera indica*, *Prunus domestica*, *Prunus persica*, *Psidium guajava* and *Pyrus* from countries where *B. dorsalis* occurs should be inspected for symptoms of infestation and those suspected should be cut open in order to look for larvae. EPPO recommends that such fruits should come from an area where *B. dorsalis* does not occur, or from a place of production found free from the pest by regular inspection for 3 months before harvest. Fruits may also be treated in transit by cold treatment (e.g. 11, 12 or 14 days at 0.5, 1.0 or 1.5°C, respectively or 19, 25 or 25 days at 5, 6 or 7°C, respectively, for temperature-sensitive fruits like mangosteens; Burikam *et al.*, 1992) or, for certain types of fruits, by vapour heat (e.g. keeping at 43°C for 4-6 h) (USDA, 1994), hot-water treatment (46°C for 65-90 min, according to size and shape of fruits; USDA, 1994), or forced hot-air treatment (Armstrong *et al.*, 1995). Ethylene dibromide was previously widely used as a fumigant but is now generally withdrawn because of its carcinogenicity; methyl bromide is less satisfactory, damaging many fruits and reducing their shelf life, although treatment schedules are available for specific cases (e.g. for cucumbers at 21-26°C, 32 g/m^3 for 2 h; USDA, 1994). Until the true pest status of the potential pest species of the *dorsalis* complex has been established, it would be reasonable to continue making these requirements for consignments from areas where any of them occur.

Plants of host species transported with roots from countries where *B. dorsalis* occurs should be free from soil, or the soil should be treated against puparia. The plants should not carry fruits. Such plants may indeed be prohibited importation.

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