Bactrocera zonata

Scientific Name
Bactrocera zonata (Saunders)

Synonyms:
Chaetodacus zonatus, Dacus (Strumeta) zonatus, Dacus ferrugineus var. *mangiferae* Cotes*, Dacus persicae, Dacus zonatus, Dasyneura zonatus, Rivellia persicae* Bigot*,* and *Strumeta zonata*

Common Names
Peach fruit fly, guava fruit fly (also refers to *Bactrocera correcta)*, Oriental fruit fly

Type of Pest
Fruit fly

Taxonomic Position
Class: Insecta, **Order:** Diptera, **Family:** Tephritidae

Reason for Inclusion in Manual
Requested by the CAPS community – not being surveyed for regularly with fruit fly funding.

Pest Description (From Fletcher (1987) and Rahman et al. (1993) unless otherwise noted)

Eggs: Elongated, elliptical, whitish and 1.0 to 1.2 mm (0.04 to 0.05 in.) long, somewhat rounded at the posterior end, slightly pointed anteriorly with a distinct micropyle.

Larvae: In general, the larvae have typical maggot characteristics with an involuted (rolled inward, spirally) head, three thoracic segments and eight abdominal segments. The three most important features of *Bactrocera* spp. (and other dacine species) are: (1) the mouth hooks, (2) the anterior spiracles, and (3) the posterior spiracles. All three change during larval development. Specific to *B. zonata*, this species has three larval instars and its spiracular openings of the respiratory system are restricted to a pair each on the prothorax and the posterior of the abdomen.

First Instar: The first instar larvae are elongated, white, and 1.7 to 2.3 mm (0.07 to 0.09 in.) long. The anterior end of the larva is narrow and pointed; while the posterior end is broad and somewhat rounded. The head region has minute yellowish-brown mouth hooks. The cephalopharyngeal (head region) skeleton is readily visible through the semi-transparent body of newly hatched larvae. The anterior portion of pharangeal sclerites is visible as small brownish dots.

Second Instar: The second instar larvae are elongated, white, and 4.0 to 6.5 mm (0.16 to 0.26 in.) long. This larval instar is characterized by the presence of anterior spiracles, each having 13 to 15 apical lobes. Each lobe has an opening. In general, most spiracles are further developed than in the first instar with a greater scleritization apparent here and in the cephalopharyngeal region.

Third Instar: The third instar larvae are yellowish-white and 9 to 10 mm (0.35 to 0.39 in.) long. The head segment now has two small jointed antennae and a single jointed maxillary palpus. The anterior respiratory spiracles with 13 to 15 lobes are still present. The anal lobes are well developed and the posterior spiracles now have fully developed transverse bars.

Figure 1. *Bactrocera zonata* adult. Photo courtesy of Natasha Wright (Florida Dept. Ag.). www.bugwood.org.

Pupae: The pupae are barrel-shaped, yellowish to yellowish-brown, 11-segmented, and 4.2 to 5.8 mm (0.16 to 0.23 in.) long x 2.3 to 2.5 mm (0.90 to 0.98 in.) wide. The anterior end has two anterior spiracles; while the posterior end is rounded. The posterior spiracles occupy the same position as in the larvae (CABI, 2009).

Adults: Adults (Fig. 1) are about 6 mm (0.24 in.) long and reddish brown with yellowish thoracic markings. They have transparent wings with a small brown spot on the tip. The face has a spot in each antennal furrow. The scutum has lateral yellow or orange vittae. The scutellum is entirely pale colored, except sometimes they possess a narrow black line across the base. The costal margin of wing without a colored band along whole length of cell r1; cell sc is usually yellow, and apex of vein R4 + 5 often with a brown spot; crossveins R-M and Dm-Cu not covered by any markings (EPPO, 2005).

Head: The head has reduced chaetotaxy, lacking ocellar and post-ocellar setae. The first flagellomere is at least three times as long as broad. It also should have a dark spot in each antennal groove, rather than a broken transverse line as in *B. correcta* (Fig. 4).

Thorax: The thorax has reduced chaetotaxy, lacking dorsocentral and katepisternal setae. Post-pronotal lobes without any setae (sometimes with some small setulae or hairs); scutum with anterior supra-alar setae and prescutellar acrostichal setae; scutellum not bilobed, with only two marginal setae (the apical pair).

Wing: Wing vein sc is abruptly bent forward at nearly 90°, weakened beyond this bend and ending at subcostal break; vein R1 with dorsal setulae; cell bcu (=cup) extension very long, equal or longer than length of vein A1 + CuA2; 4 to 6 mm (0.16 to 0.24 in.) long. Raised narrow subbasal section of cell br lacking microtrichiae.

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 pectin) on each side of tergite three.

Biology and Ecology

Bactrocera zonata is a pest mainly on peach (and other stone fruit), mango, guava, and papaya, but it can be found on many other wild and cultivated fruits, including *Citrus* spp. It readily disperses as far as 15 miles (79200 ft.; 24140 m) both early and late in the growing season, even when hosts are abundant (Fletcher, 1989). It can outcompete other fruit fly pests (due to its shorter larval development time, larger egg size, longer lifespan and/or reproductive output) including *Ceratitus capitata, C. rosa* and *B. dorsalis* (Duyck et al., 2006a, 2007; CABI, 2009). *Bactrocera zonata* lives and reproduces over a longer time frame, tolerates a lower relative humidity, and its pupae can survive submersed in soil much longer than these competitor species (Marwat et al., 1992; Saafan et al., 2005; Duyck et al., 2006b).

This fruit fly is active throughout the year at temperatures at or above 10°C (50°F), and development of all life stages stops at temperatures below 10°C. The optimum temperatures for activity (feeding, egg laying, etc.) and development is 25 to 29°C (77 to 85°F). Flies are not active at temperatures over 35°C (95°F) or at night. Adults have been seen as early as the end of March and as late as mid-November (Qureshi et al., 1993; Hussain, 1995; Duyck et al., 2004). When reared in the laboratory, the average adult lifespan is 56 days for males, 62 for females (Hussain, 1995), with three to nine overlapping generations per year. Adults need to feed on nectar, plant sap, and decaying fruit to mature sexually and for general survival. Feeding normally takes place in the morning, but is also done during full daylight and this activity is probably temperature dependent. Night is spent under foliage or any other protective crevices of hosts and non-hosts.

From pupae, adults emerge in the morning and then need a 10- to 16-day maturation process before they become reproductively mature. After this, they begin mating, which normally takes place at dusk. Oviposition begins when immature fruit appear, and seems to be greatest (and most successful) when adult females are 35 days old and immature fruits are about 38.1 mm (1.5 in.) in diameter (Hussain, 1995; CABI, 2009). Females puncture the skin of the fruit (yellow-colored hosts seem to be preferred over green and colorless hosts (Hussain, 1995), create a small cavity and lay three to nine eggs. An average female lays 137 eggs in her lifetime (CABI, 2009). Oviposition can occur at any time during the day, but most often happens in the late afternoon and early evening (Rahman et al., 1993). Larvae hatch as early as one day after the eggs are laid and feed within the fruit for four to 21 days. After maturing, they drop to the ground and burrow into the soil to pupate. The pupal stage can last from four weeks in the summer to six weeks in the winter. This species overwinters as pupae in areas where true diapause is necessary (CDFA, 2011).

Two temperatures, 16°C (60°F) and 25°C (77°F), seem to be important thresholds for *B. zonata*. While development can continue at temperatures lower than 16°C, adult emergence dropped to 1%, and egg (10%), larval (46%), and pupal (13%) survival are much lower than the corresponding results seen at 20°C (68°F), 25°C, and 30°C (86°F). The highest emergence and survival rates were recorded at 25°C; adult emergence (70%), egg (71%), larval (98%) and pupal (100%) survival were higher at 25°C than at any other temperature (Hussain, 1995; Duyck et al., 2004). Egg development was the fastest at 25°C and 30°C, and larval, pupal and ovarian developments were the fastest at 30°C.

In Egypt, studies performed on different hosts (citrus, stone fruit, mango, guava, etc.) resulted in an average of 493 thermal units (day degrees) required to complete one generation (Khalil et al., 2010).

In Europe, *B. zonata* is most common in private gardens where different host species fruit throughout the year and are available; commercially it is most common in orchards of peach, fig, and guava. Adults can survive winters with temperatures at or close to freezing in North Sinai, Egypt.

Control/eradication measures for *B. zonata* currently use a combination of two techniques; the Male Annihilation Technique (MAT) and the Bait Application Technique (BAT). In the United States, the MAT uses the Jackson trap, lure and insecticide combination, but other types of traps/lures are used as well. The BAT involves placing small amounts (40 to 100 mL (1.35 to 3.38 oz.) of a protein bait mixed with an

Figure 2. Damage from egg laying of *B. zonata* on peaches. Left: Notice the clear resin-like fluid coming from the lower right of the peach. Right: Oviposition scars on peach. Photos courtesy of Ian White and Rui Cardoso.

insecticide on various parts of an infested area (*e.g.,* tree trunks, leaves, inside traps). Adult flies consume this protein/insecticide mix and die. In Pakistan, a BAT formulation of 3 mL (0.1 oz.) malathion 57% *a.i.* EC and 30 mL commercial protein hydrolysate in 1 L (0.26 gal.; 33.8 oz.) of water significantly reduced infestation rates in guava, melon, and jujube at a rate of 7.5 L/hectare/week (Stonehouse et al., 2002). Care should be taken to avoid placing this bait where it would come into contact with children, livestock and/or pets. In addition to malathion, spinosad, diazinon and naled (Dibrom) are also recommended for BAT and MAT.

Symptoms/Signs

The first sign of *B. zonata* attack is a small puncture wound (scar) where a female has oviposited within an immature fruit (Fig. 2). Oftentimes, a droplet of fluid exudes from the fruit and dries as a clear or brown resinous spot. As larvae develop inside the fruits, the second and third instar larvae feed deeper in the fruit. They seem to be the main reason for the complete deterioration of the individual fruit and cause premature fruit drop.

Pest Importance

Economic impacts are twofold; the direct loss of the crop from larval damage and the loss of export markets or costly quarantine/importation/eradication treatments required by importing countries once *B. zonata* has been detected. Across Asia, crop losses due to *B. zonata* can be significant (25 to 100% loss in some areas and fruits). Egypt has seen infestation rates of 20% in apricot (Saafan et al., 2005). In Pakistan, infestation rates are so high that certain crops (*e.g.,* papaya) are not grown or harvested.

On November 10, 2010, an adult *B. zonata* male was captured in a trap in a *Psidium guajava* (guava) tree in Miami-Dade County, Florida. This is the first report of *B. zonata* in Florida. Trapping has been intensified in the 81-square-mile area surrounding the detection site.

Known Hosts

Major hosts include: *Carica papaya* (papaya), ***Mangifera indica*** **(**mango**),** ***Prunus persica*** **(peach), and** ***Psidium*** **spp. (guava).**

Minor hosts include: *Abelmoschus esculentus* (okra), ***Aegle marmelos*** **(**bael fruit**),** *Annona* spp. (custard/sugar apple), ***Afzelia xylocarpa*** **(**makamong**)*****, Careya arborea*** **(kumbhi),** *Citrofortunella* spp. (**calamondin)**, *Citrullus lanatus* (watermelon)*, Citrus* spp. (citrus), *Coccinia grandis* (ivy gourd), *Cucurbita* spp. (gourd), *Cucumis* spp. (cantaloupe, cucumber), *Cydonia oblonga* (quince)*, Elaeocarpus* spp. (Japanese blueberry), *Eriobotrya japonica* (loquat), *Eugenia* spp. (kelat), *Feijoa sellowiana* (feijoa), *Ficus* spp. (fig), *Fortunella japonica* (round/Marumi kumquat), ***Grewia asiatica*** **(**phalsa)**,** ***Lagenaria siceraria*** **(bottle gourd),** ***Luffa*** **spp. (loofah),** ***Madhuca indica*** **(butter tree),** ***Malpighia glabra*** **(acerola),** *Malus* spp. (apple), *Manilkara* spp. (Brazilian redwood/sapodilla), ***Momordica charantia*** **(**balsam apple/bitter gourd)**,** *Ochrosia elliptica* (**elliptic yellowwood)**, ***Olea europaea*** **(olive),** *Persea americana* (**avocado)**, ***Phoenix spp.*** **(date palm),** ***Prunus armeniaca*** **(apricot),** ***Punica*** **spp.**

(pomegranate), *Putranjiva roxburghii* (**putranjiva)**, ***Pyrus* spp. (pear), *Sapota* spp. (sapota), *Solanum lycopersicon* (tomato), *Solanum melongena* (eggplant), *Syzygium jambos* (rose apple), *Terminalia catappa* (beach/tropical almond/myrobalan), and *Ziziphus mauritiana* (jujube) (**Kapoor, 1993; Allwood et al., 1999; CABI, 2009; CDFA, 2011).

According to CDFA (2011), *B. zonata* attacks early fruit such as jujube, loquat, and peach, then moves to cucurbits, mango, citrus, guava, pomegranate, and sapodilla for the rest of the year.

Known vectors (or associated organisms)

Bactrocera zonata is not a known vector and does not have any associated organisms.

Known Distribution

B. zonata is native to south and southeast Asia.

Asia: Bangladesh, Bhutan, India, Iran, Laos, Moluccas Islands, Myanmar, Nepal, Oman, Pakistan, Saudi Arabia, Sri Lanka, Thailand, United Arab Emirates, Vietnam and Yemen. **Africa:** Egypt, Libya, Mauritius, and Réunion.

Bactrocera zonata has been previously eradicated in Israel and the United States (California (2006) and Florida (2011)). *B. zonata* has also been erroneously listed as present in Indonesia and Nepal.

Potential Distribution within the United States

Bactrocera zonata and *B. dorsalis* occupy the same ecological niche. In other words, places where *B. dorsalis* can invade are nearly identical to the area where *B. zonata* can exist as well.

Bactrocera zonata is a tropical species, and any areas with an upper temperature threshold of 35°C (95°F) are potential establishment sites (Duyck et al., 2004). Also, in field observations, adults of *B. zonata* were seen to be most abundant when the temperatures were 26 to 30°C (79 to 86°C) and the relative humidity was 70 to 75% (Saafan et al., 2005 and references therein). Areas with these climatic characteristics can be considered acceptable habitats for *B. zonata*.

B. zonata is only considered a threat to the following states and territories: Alabama, Arizona, California, Florida, Georgia, Guam, Hawaii, Louisiana, the Mariana Islands, Mississippi, New Mexico, Puerto Rico, South Carolina, Texas, and the U.S. Virgin Islands.

Survey

CAPS-Approved Method*: The CAPS approved method is a trap and lure combination. The trap type is a Jackson trap. The lure is methyl eugenol with an insecticide. The Jackson trap is a delta-shaped, disposable trap with an adhesive-coated, removable insert that is used to capture male *B. zonata*, as well as other *Bactrocera* spp.

IPHIS Survey Supply Ordering System Product Names:

1) Fruit Fly, Methyl Eugenol Lure
2) Jackson Trap Body

Before planning a *B. zonata* survey, it is IMPERATIVE that you work with your CAPS Regional Program Manager and your regional PPQ Fruit Fly Program Manager for guidance in planning your survey (see contact information below).

Joe Beckwith-- PPQ Eastern Region Fruit Fly Program Manager
919-855-7345
joseph.s.beckwith@aphis.usda.gov

Shaharra J Usnick-- PPQ Western Region Fruit Fly Program Manager
970-494-7571
Shaharra.j.usnick@aphis.usda.gov

Lure Placement: Placing lures for two or more target species in a trap should never be done unless otherwise noted here.

Lure Notes: The lures used for *B. zonata* surveys require specific equipment and certification of personnel, due to the necessary addition of an insecticide. For this reason, please consult with your regional Plant Protection and Quarantine (PPQ) Fruit Fly Program Manager before ordering lures. The insecticide component is not available through the PPQ Survey Supply Ordering System. Please work with your Fruit Fly Program Manager for assistance in procuring the insecticide.

Due to the climatic requirements of *B. zonata*, surveys are only relevant for the following states: Alabama, Arizona, California, Florida, Georgia, Louisiana, Mississippi, New Mexico, South Carolina, and Texas.

*For the most up-to-date methods for survey and identification, see Approved Methods on the CAPS Resource and Collaboration Site, at http://caps.ceris.purdue.edu/.

Literature-Based Methods: Adults are the main survey life stage; reproductively mature males of *B. zonata* (and other *Bactrocera* species) are easily attracted to methyl eugenol (4-allyl-1,2-dimethoxybenzene or 3,3,dimethoxy(1)2 propenyl benzene), and this chemical attractant is currently used in the United States to monitor for *Bactrocera* spp. A cotton wick or polymeric plug of methyl eugenol and an insecticide (malathion, naled or Dichlorovos) in a 3:1 ratio is suspended inside a delta-shaped Jackson trap with sticky material. When male fruit flies enter the trap and feed on the lure, they die and become stuck. Thickeners (*e.g.,* Min-U-Gel 400) have also been used to increase the efficacy and longevity of methyl eugenol (Kapoor, 1993). In Pakistani guava/ mango orchards, pheromone traps performed best at capturing males when they were colored yellow or green (Hussain et al., 1995). Male attraction toward methyl eugenol increases as they sexually mature and wanes when they have previously been exposed to a significant amount of this chemical; methyl eugenol is found naturally in some of their foods (Shelly, 1994). Steiner traps can be used as a substitute for Jackson traps in male survey programs.

Key Diagnostics/Identification

CAPS-Approved Method*: This species can be identified by examining its form and structure (morphological characteristics). It can be distinguished from many of the *Bactrocera* species by wing patterns, spots on its head, lines on its thorax, and abdominal markings.

*For the most up-to-date methods for survey and identification, see Approved Methods on the CAPS Resource and Collaboration Site, at http://caps.ceris.purdue.edu/.

Literature-Based Methods: Larvae of *B. zonata* can be differentiated from *B. cucurbitae* and *B. dorsalis* by differences in the anterior spiracles, cephalopharyngeal skeleton and the posterior spiracular plate (Khan and Khan, 1987). Rearing larvae through to adults, however, is the most accurate way to differentiate between different larvae found in stone fruit. Important references for larvae include White and Elson-Harris (1992) and Pest fruit flies of the world – larvae (http://delta-intkey.com/ffl/www/_wintro.htm).

An excellent online resource by White (2000) providing distinguishing characteristics between *B. zonata* adults and all other known species in the tribe Dacini (includes the genera *Bactrocera, Dacus,* and *Monacrostichus*) can be found at: http://www.iaea.org/programmes/.nafa/d4/public/zonata.html. More extensive keys to *Bactrocera* species can be found in White (2006).

This website walks the reader through marks on the wing (costal band reduced to a small apical spot, lack of microtrichia and anal streak, Fig. 3), head (two spots, one in each antennal furrow, Fig. 4), thorax (thin lateral yellow stripe running down each side, Fig. 5) and abdomen (usually two dark marks on tergite 3, Fig. 5) to identify *B. zonata*.

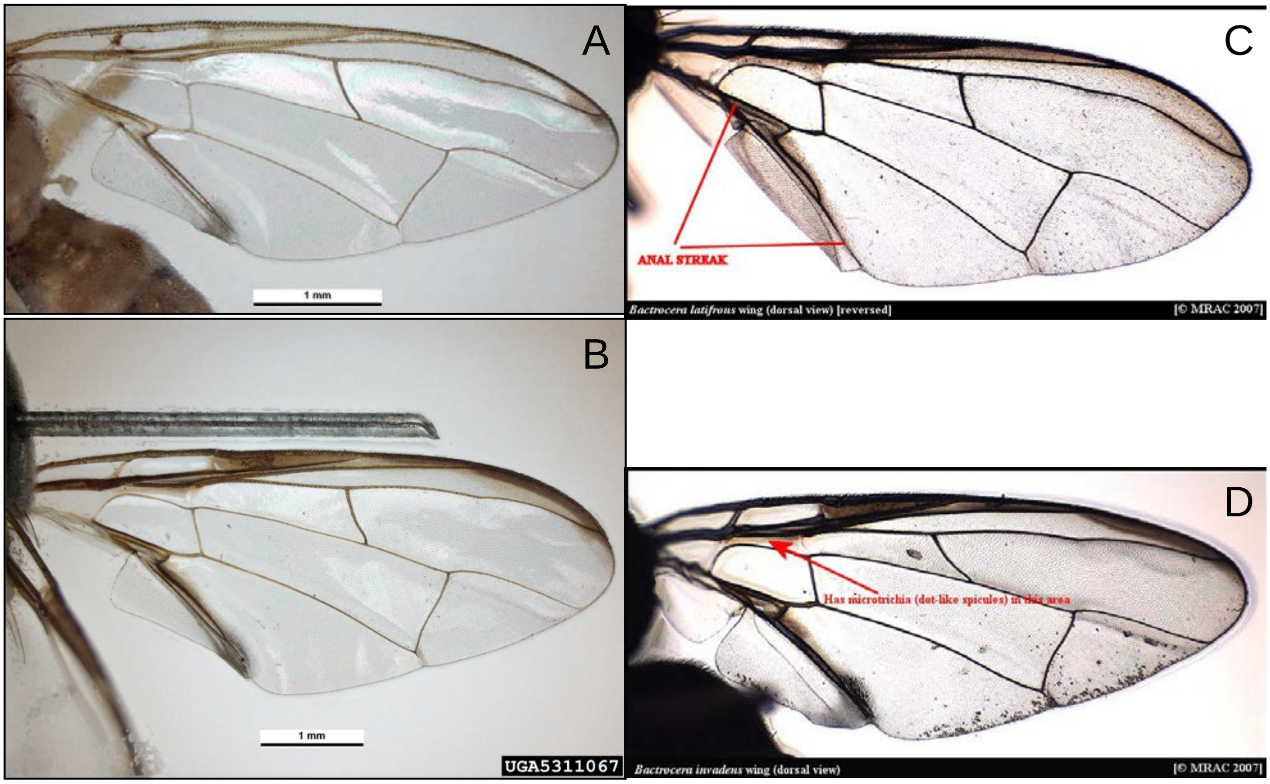

Figure 3. A. Wing of *B. zonata*: note the small brown apical spot on the tip of the wing (Ken Walker, http://www.padil.gov.au/). **B.** Wing of *B. dorsalis*: the costal band at the top of the wing is now not just a spot, but a full band (Pest and Diseases Image Library, http://www.bugwood.org/). **C and D.** Wing of *B. latifrons* with an apparent anal streak and microtrichia, something the wing of *B. zonata* lacks (Royal Museum for Central Africa).

Finally, molecular Identification has been studied to identify *B. zonata*, and a protocol using mitochondrial cytochrome oxidase I has been developed (Asokan et al., 2007).

Easily Confused Pests

Bactrocera zonata can be confused with other *Bactrocera* spp.

Figure 4. Left: Head of *B. dorsalis* with brown spot in the antennal furrow (red arrow) (Ken Walker, http://www.padil.gov.au/). Right: Head of *B. correcta* with a broken transverse line in the antennal grove instead of a spot (red arrow) (Pest and Diseases Image Library, http://www.bugwood.org/).

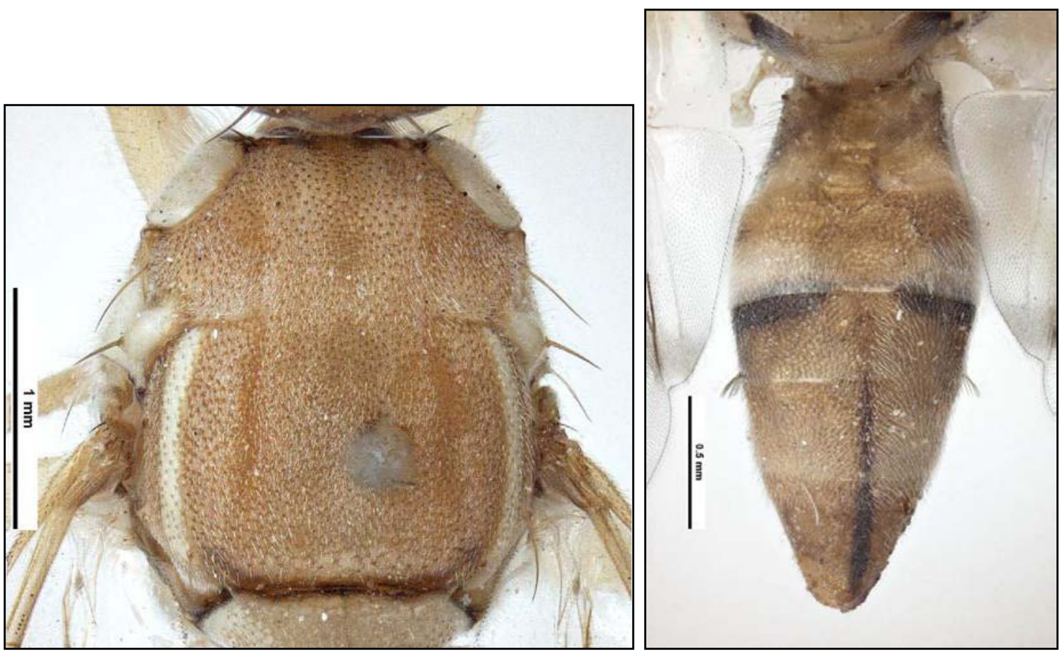

Figure 5. Left: *B. zonata* thorax with the two lateral yellow stripes. Right: *B. zonata* abdomen, with the stripes on tergite 3. Photos courtesy of Ken Walker, http://www.padil.gov.au/.

References

Allwood, A.J., Chinajariyawong, A., Kritsaneepaiboon, S., Drew, R.A.I., Hamacek, E.L., Hancock, D.L. Hengsawad, C., Jipanin, J.C., Jirasurat, M., Kong Krong, C., Leong, C.T.S., and Vijaysegaran, S. 1999. Host plant records for fruit flies (Diptera: Tephritidae) in southeast Asia. The Raffles Bulletin of Zoology Supplement 7: 1-92.

Asokan, R., Krishna Kumar, N.K., and Verghese, A. 2007. Molecular identification of fruit flies, *Bactrocera* spp. (Diptera: Tephritidae) using mitochondrial cytochrome oxidase I. Current Science 93(12): 1668-1669.

CABI. 2009. Crop Protection Compendium. Wallingford, UK: CAB International. www.cabicompendium.org/cpc.

CDFA. 2011. Peach Fruit Fly Pest Profile. Accessed on January 5, 2011 from: http://www.cdfa.ca.gov/phpps/pdep/target_pest_disease_profiles/peach_ff_profile.html.

Duyck, P.F., Sterlin, J.F., and Quilici, S. 2004. Survival and development of different life stages of *Bactrocera zonata* (Diptera: Tephritidae) reared at five constant temperatures compared to other fruit fly species. Bulletin of Entomological Research 94: 89-93.

Duyck, P.F., David, P., Junod, G., Brunel, C., Dupont, R. and Quilici, S. 2006a. Importance of competition mechanisms in successive invasions by polyphagous tephritids in La Réunion. Ecology 87(7): 1770-1780.

Duyck, P.F., David, P., and Quilici, S. 2006b. Climatic niche partitioning following successive invasions by fruit flies in La Réunion. Journal of Animal Ecology 75: 518-526.

Duyck, P.F., David, P., and Quilici, S. 2007. Can more *K*-selected species be better invaders? A case study of fruit flies in La Réunion. Diversity and Distributions 13:535-543.

EPPO. 2005. Bulletin OEPP/EPPO 35: 371-373.

Fletcher, B.S. 1987. The biology of dacine fruit flies. Annual Review of Entomology 32: 115-144.

Fletcher, B.S. 1989. Movements of Tephritid Fruit Flies. In World Crop Pests: Fruit Flies. Their biology, Natural Enemies and Control, Vol. 3B, eds. Robinson, AS and Hooper, G. pg. 209-219.

Hussain, T. 1995. Demography and population genetics of *Dacus zonatus* (Suanders). Thesis, University of the Punjab, Pakistan. 308 pp.

Hussain, T, Siddiqui, Q.H., and Qureshi, Z.A. 1995. Visual responses of *Bactrocera zonata* (Saunders) to traps of different colors. Proceedings of the Pakistan Congress of Zoology 15: 313-318.

Kapoor, V.C. 1993. Indian Fruit Flies. Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi, 228 pp.

Khalil, A.A, Abolmaaty, S.M., Hassanein, M.K., El-Mtewally, M.M. and Moustafa,S.A. 2010. Degree-day units and expected generation numbers of peach fruit fly *Bactrocera zonata* (Saunders) (Diptera:Tephritidae) under climate change in Egypt. Egyptian Academy Journal of Biological Science 3(1): 11-19.

Khan, R.J. and Khan, M.A. 1987. A comparative morphological study on third instar larvae of some *Dacus* species (*Tephritidae: Diptera*) in Pakistan. Pakistan Journal for Scientific and Industrial Research 30(7): 534-538.

Marwat, N.K., Hussain, N. and Khan, A. 1992. Suppression of population and infestation of *Dacus* spp. by male annihilation in guava orchard. Pakistan Journal of Zoology 24(1): 82-84.

Qureshi, Z.A., Hussain, T., Carey, J.R., and Dowell, R.V. 1993. Effects of temperature on development of *Bactrocera zonata* (Saunders)(Diptera:Tephritidae). Pan-Pacific Entomologist 69(1): 71-76.

Rahman, O., Rahman, S., and Agarwal, M.L. 1993. Biology and immature stages of *Dacus* (*Bactrocera*) *zonatus* (Saunders)(Diptera:Tephritidae). Journal of Animal Morphology and Physiology 40: 45-52.

Saafan, M.H., Foda, S.M., and Abdel-Hafez, T.A. 2005. Ecological studies of flies on different hosts at Fayoum Governorate. 3 – Ecological Studies of Mediterranean fruit fly, *Ceratitis capitata* (Wied.) and Peach fruit fly, *Bactrocera zonata* (Saund.) in apricot orchards. Egyptian Journal of Agricultural Research 83(4) 1635-1648.

Shelly, T.E. 1994. Consumption of methyl eugenol by male *Bactrocera dorsalis* (Diptera:Tephritidae) low incidence of feeding. Florida Entomologist Online 77(2): 201-208.

Stonehouse, J., Mahmood, R., Poswal, A., Mumford, J., Baloch, K.N., Chaudhary, Z.M., Makhdum, A.H., Mustafa, G., and Huggett, D. 2002. Farm field assessments of fruit flies (Diptera:Tephritidae) in Pakistan: distribution, damage and control. Crop Protection 21: 661-669.

White, I.M. 2000. Identification of Peach Fruit Fly, *Bactrocera zonata* (Saunders), in The Eastern Mediterranean. http://www.iaea.org/programmes/.nafa/d4/public/zonata.html.

White, I. M. 2006. Taxonomy of the Dacina (Diptera: Tephritidae) of Africa and the Middle East. African Entomology Memoir No. 2: 156 p. + CD-ROM.

White, I. M. and Elson-Harris, M.M. 1992. Fruit flies of economic significance: their identification and bionomics. CAB International. Wallingford, UK. 601p.