EPPO Datasheet: *Anastrepha fraterculus*

Last updated: 2021-07-28

IDENTITY

Preferred name: *Anastrepha fraterculus*
Authority: (Wiedemann)
Taxonomic position: Animalia: Arthropoda: Hexapoda: Insecta: Diptera: Tephritidae
Other scientific names: *Acrotoxa fraterculus* (Wiedemann), *Anastrepha braziliensis* Greene, *Anastrepha costarukmanii* Capoor, *Anastrepha fraterculus var. soluta* Bezzi, *Anastrepha lambayecae* Korytkowski & Ojeda, *Anastrepha peruviana* Townsend, *Anastrepha pseudofraterculus* Capoor, *Anastrepha scholae* Capoor, *Anastrepha soluta* Bezzi, *Anthomyia frutalis* Weyenburgh, *Dacus fraterculus* Wiedemann, *Tephritis mellea* Walker, *Trypeta fraterculus* (Wiedemann), *Trypeta unicolor* Loew
Common names: South American fruit fly
view more common names online...
EPPO Categorization: A1 list
view more categorizations online...
EU Categorization: A1 Quarantine pest (Annex II A)
EPPO Code: ANSTFR

Notes on taxonomy and nomenclature

Populations previously treated as *Anastrepha fraterculus* (Wiedemann) are now considered to be a complex of multiple cryptic, or morphologically very similar, species (Hendrichs *et al.*, 2015). Despite tremendous progress in the past decade in terms of investigating the individual species, their morphological diagnosis remains problematic, the status of some populations remains unresolved, and the full geographic distributions and host ranges of most of the species are uncertain.

Currently eight ‘morphs’ (Andean, Brazil-1, Brazil-2, Brazil-3, Ecuadorean, Mexican, Peruvian, lowland Venezuelan) have been recognized by morphometric analysis (Hernández-Ortiz *et al*., 2012, 2015). Most of these also can be diagnosed by molecular methods (ITS1 sequences) (Sutton *et al.*, 2015, Prezotto *et al.*, 2019), although it remains unclear if the Andean and Ecuadorian morphs are distinct and if the lowland Venezuelan morph, which has been less well studied, is distinct from the Mexican morph. Recently, additional populations with different ITS1 types have been discovered in Suriname, Brazil and the Amazon (Sutton *et al*., unpublished). Studies based on various other types of data, including isozymes, karyotypes, mating incompatibility, pheromones, and pest status (e.g., see Steck, 1991, 1999, Hernández-Ortiz *et al.*, 2004, Selivon *et al*., 2005, Vera *et al*., 2006, Cáceres *et al.*, 2009, Rull *et al.*, 2013, Devescovi *et al.* 2014, but also Alberti *et al.*, 2002), indicate that the majority of the morphs are clearly not conspecific.

The oldest name pertaining to the complex is *Dacus fraterculus* Wiedemann, 1830. The current combination was proposed by Wulp (1899). Ten other names are currently recognized as synonyms of *A. fraterculus* but remain available and may become valid in the future when the cryptic species within the *Anastrepha fraterculus* complex are formally recognized.

The infrageneric classification of *Anastrepha* consists of more than 30 informal species groups (as opposed to formal subgenera). The *fraterculus* complex should not be confused with the larger *fraterculus* species group, which includes the *fraterculus* complex as well as more than 40 other species.

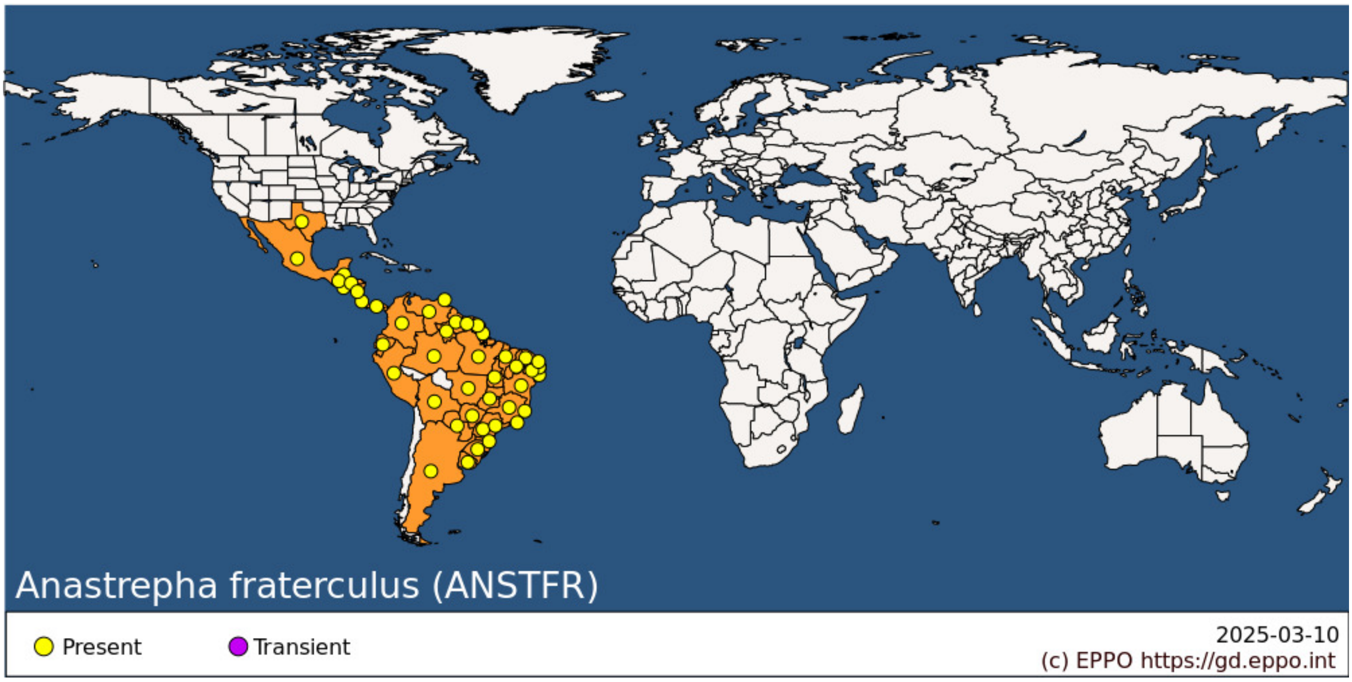
HOSTS

The *fraterculus* complex as a whole is broadly polyphagous (Norrbom, 2004), with over 200 reported host plants, but many preferred hosts are Myrtaceae, particularly guava (*Psidium guajava*). Other cultivated mytaceous hosts include other *Psidium* spp., feijoa (*Acca sellowiana*), *Campomanesia* spp., rose apple (*Syzygium jambos*), Surinam cherry and other *Eugenia* species, and nearly 40 wild myrtaceous hosts have been reported. *Prunus* spp., especially peach (*P. persica*), loquat (*Eriobotrya japonica*), and chirimoya (*Annona cherimola*) are commonly reported hosts. Tropical almond (*Terminalia catappa*), widely planted as an ornamental, and coffee (*Coffea arabica*), in which the fruit is infested but the bean is not damaged, are important reservoir hosts (Rodríguez & Arévalo, 2015). Apple (*Malus domestica*), mango (*Mangifera indica*), and *Citrus* spp. are among the cultivated crops attacked in Southern Brazil, although most of the primary hosts are Myrtaceae (Salles, 1995). Guava, feijoa, blackberry (*Rubus glaucus*), and peach are among the commercial crops attacked in Colombia (Rodríguez & Arévalo, 2015), and chirimoya, loquat, guava and peach are favored host plants in the inter-Andean parts of Ecuador and guava, mango, *Inga* spp. and other *Psidium* spp. are attacked in other parts of the country (Molineros et al. 1992). Guava, Surinam cherry, grapefruit, cherimoya, apricot, plum and peach are significant hosts in Argentina (Ovruski *et al.*, 2003, Segura *et al.*, 2006).

Host list: *Acanthosyris sp.*, *Acca sellowiana*, *Actinidia deliciosa*, *Alchornea latifolia*, *Ampelocera hottlei*, *Anacardium occidentale*, *Andira humilis*, *Annona cherimola*, *Annona crassiflora*, *Annona dolabripetala*, *Annona emarginata*, *Annona muricata*, *Annona neosericea*, *Annona reticulata*, *Annona rugulosa*, *Annona squamosa*, *Averrhoa carambola*, *Bellucia grossularioides*, *Bunchosia armeniaca*, *Butia eriospatha*, *Byrsonima crassifolia*, *Calycolpus moritzianus*, *Campomanesia adamantium*, *Campomanesia aromatica*, *Campomanesia espiritosantensis*, *Campomanesia guaviroba*, *Campomanesia guazumifolia*, *Campomanesia lineatifolia*, *Campomanesia pubescens*, *Campomanesia sp.*, *Campomanesia xanthocarpa*, *Capsicum annuum*, *Carica papaya*, *Casearia laetioides*, *Celtis iguanaea*, *Chrysobalanus icaco*, *Chrysophyllum cainito*, *Chrysophyllum gonocarpum*, *Chrysophyllum mexicanum*, *Citrus maxima*, *Citrus medica*, *Citrus myrtifolia*, *Citrus reticulata*, *Citrus trifoliata*, *Citrus x aurantiifolia*, *Citrus x aurantium var. clementina*, *Citrus x aurantium var. paradisi*, *Citrus x aurantium var. sinensis*, *Citrus x aurantium*, *Citrus x limon var. limetta*, *Citrus x limon var. limettioides*, *Citrus x limon*, *Citrus x limonia*, *Citrus x tangelo*, *Clausena lansium*, *Coffea arabica*, *Coffea liberica*, *Cryptocarya aschersoniana*, *Cydonia oblonga*, *Diatenopteryx sorbifolia*, *Diospyros kaki*, *Dovyalis abyssinica*, *Dovyalis hebecarpa*, *Endlicheria paniculata*, *Eriobotrya japonica*, *Eugenia dombeyi*, *Eugenia dysenterica*, *Eugenia florida*, *Eugenia gemmiflora*, *Eugenia involucrata*, *Eugenia lambertiana*, *Eugenia myrcianthes*, *Eugenia platyphylla*, *Eugenia platysema*, *Eugenia pyriformis*, *Eugenia sp.*, *Eugenia stipitata*, *Eugenia uniflora*, *Ficus carica*, *Fortunella japonica*, *Fortunella margarita*, *Fragaria vesca*, *Fragaria x ananassa*, *Garcinia brasiliensis*, *Helicostylis tomentosa*, *Inga edulis*, *Inga feuillei*, *Inga insignis*, *Inga sellowiana*, *Inga semialata*, *Inga spectabilis*, *Inga vera subsp. vera*, *Jacaratia heptaphylla*, *Juglans australis*, *Juglans neotropica*, *Juglans regia*, *Malpighia emarginata*, *Malpighia glabra*, *Malus domestica*, *Mammea americana* , *Mangifera indica*, *Manilkara zapota*, *Matisia cordata*, *Melicoccus bijugatus*, *Melicoccus oliviformis*, *Mouriri acutiflora*, *Mouriri glazioviana*, *Myrceugenia euosma*, *Myrcia popayanensis*, *Myrcia sp.*, *Myrcia tomentosa*, *Myrcianthes fragrans*, *Myrcianthes pungens*, *Myrciaria dubia*, *Myrciaria floribunda*, *Myrciaria glazioviana*, *Myrciaria glomerata*, *Myrciaria strigipes*, *Olea europaea*, *Passiflora alata*, *Passiflora caerulea*, *Passiflora edulis*, *Passiflora sp.*, *Passiflora tripartita*, *Peritassa campestris*, *Persea americana*, *Picramnia sp.*, *Planchonella obovata*, *Plinia cauliflora*, *Plinia edulis*, *Pourouma sp.*, *Pouteria caimito*, *Pouteria campechiana*, *Pouteria gardneriana*, *Pouteria glomerata*, *Pouteria lucuma*, *Pouteria ramiflora*, *Pouteria torta*, *Prunus armeniaca*, *Prunus avium*, *Prunus domestica subsp. insititia*, *Prunus domestica*, *Prunus dulcis*, *Prunus mume*, *Prunus persica var. nucipersica*, *Prunus persica*, *Prunus salicina*, *Prunus sellowii*, *Prunus serotina var. salicifolia*, *Psidium acutangulum*, *Psidium cattleyanum*, *Psidium guajava*, *Psidium guineense*, *Psidium myrtoides*, *Psidium oligospermum*, *Psidium striatulum*, *Punica granatum*, *Pyrus communis*, *Rubus glaucus*, *Rubus idaeus*, *Rubus ulmifolius*, *Sarcomphalus joazeiro*, *Selenicereus megalanthus*, *Sideroxylon capiri subsp. tempisque*, *Simaba guianensis*, *Solanum aligerum*, *Solanum betaceum*, *Solanum decompositiflorum*, *Solanum nudum*, *Solanum quitoense*, *Spondias dulcis*, *Spondias mombin*, *Spondias purpurea*, *Spondias radlkoferi*, *Spondias tuberosa*, *Syagrus romanzoffiana*, *Syzygium aqueum*, *Syzygium jambos*, *Syzygium malaccense*, *Terminalia catappa*, *Theobroma cacao*, *Turpinia occidentalis*, *Vaccinium virgatum*, *Vitis labrusca*, *Vitis vinifera*, *Ximenia americana*, *Ziziphus mauritiana*

GEOGRAPHICAL DISTRIBUTION

The full range of the *fraterculus* complex extends from Northern Mexico to Northern Argentina (Hernández-Ortiz 1992, Hernández-Ortiz *et al.*, 2015, Sutton *et al.*, 2015). The Mexican morph occurs from Northern Mexico through Central America to at least Colombia. It has been trapped sporadically in the Rio Grande Valley of Texas (USA), but is not currently considered established. The lowland Venezuelan form is recorded only from lowland areas of Western Venezuela. The Andean morph occurs in the Andes in Western Venezuela and Colombia, and the Ecuadorian morph in the Andes in Ecuador and Peru. The Peruvian morph occurs at lower, drier elevations in Southern Colombia, Ecuador and Peru. It is invasive in the Galapagos Islands (Harper *et al.*, 1989). Three morphs occur in Brazil (Vaní?ková *et al.*, 2015, Prezotto *et al.*, 2019). The Brazil-2 and Brazil-3 morphs occur only in Brazil, whereas the Brazil-1 morph occurs in Southeastern and Southern Brazil, Uruguay, Northern Argentina, Paraguay, Bolivia and highland areas of Southern Peru. It is presumed to be invasive in at least the latter two countries. An invasive population in Chile (morph unknown) was eradicated (Enkerlin *et al.*, 1989).



North America: Mexico, United States of America (Texas)
Central America and Caribbean: Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Panama, Trinidad and Tobago
South America: Argentina, Bolivia, Brazil (Alagoas, Amapa, Amazonas, Bahia, Ceara, Espirito Santo, Goias, Maranhao, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Para, Paraiba, Parana, Pernambuco, Piaui, Rio de Janeiro, Rio Grande do Norte, Rio Grande do Sul, Roraima, Santa Catarina, Sao Paulo, Tocantins), Colombia, Ecuador, French Guiana, Guyana, Paraguay, Peru, Suriname, Uruguay, Venezuela

BIOLOGY

Many aspects of the biology of the *fraterculus* complex were reviewed by Cladera *et al.* (2014). As in *Anastrepha* species generally, the life cycle includes: the egg, 3 larval stages, pupa, and adult. Eggs are laid in the host fruit and all three larval stages feed in the flesh of the fruit. Mature larvae exit the fruit and pupariate in the soil. Salles (2000) presented a table showing the length of development (presumably for the Brazil-1 morph) at temperatures from 15-30°C. At 25°C the eggs hatch in 2.6-3.2 days and the larvae feed for another 11-14 days (up to 34.5 days at 15°). Adults emerge after a 10-15 day (43.2 days at 15°) pupal stage and may live up to 161 days in laboratory conditions. Females can produce 200-437 eggs (Salles, 2000, Cladera *et al.*, 2014). Adult males produce a pheromone and lek to attract females for mating (Aluja *et al.*, 1999). There is no winter diapause or quiescence in more temperate areas such as Southern Brazil (Salles & Carvalho, 1993).

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

Immature stages

The identification of larvae of *Anastrepha* species, as is the case for most fruit flies, is extremely difficult. Larvae have been described for only 9% of the species of *Anastrepha* (Steck *et al*., 2019). The *fraterculus* complex is included in the key of Steck *et al*. (1990) and the interactive key of Carroll *et al.* (2004) to third stage larvae, but it cannot be reliably distinguished from similar species such as *A. obliqua* and *A. suspensa* (Rodriguez *et al.*, 2021). Steck *et al.* (1990), White & Elson-Harris (1992), Carroll *et al.* (2004), Frías *et al.* (2006), and Canal *et al.* (2015), summarized by Rodriguez *et al.* (2021), provided at least partial descriptive information on the third instar for the Andean, Brazil-1, Ecuadorian, Mexican, and Peruvian morphs, and Canal *et al.* (2015) conducted a morphometric analysis of these morphs.

As in other *Anastrepha* species, the larva is whitish, lacking an external head capsule, tapered anteriorly and truncate posteriorly. The two mandibles, or mouthhooks, are strongly developed and equal in size. The posterior spiracular plate is weak, unpigmented, without a peritreme, with three openings or slits arranged with their medial ends converging, the dorsal and ventral slits subparallel or oriented at less than 90°.

The following diagnostic description of the third instar is based on Carroll *et al.* (2004) and Rodriguez *et al*. (2021): Length 4.9-11.0 mm. Head: Stomal sensory organ with primary lobe large, elongate-rounded, with 3 small sensilla; 7-11 oral ridges with margins irregularly serrate, scalloped, or emarginate; 8-11 serrate accessory plates; mandible moderately sclerotized, 0.15-0.18 mm long, with single large slender curved apical tooth. Thoracic and abdominal segments: T1-T2 and sometimes T3 and A1-A3 middorsally with rows of spinules; A4-A8 without dorsal spinules medially; caudal segment with tubercles and 10 pairs of sensilla small but obvious. Anterior spiracle bilobed, with 9-18 tubules in single row. Posterior spiracle with spiracular slits about 2.7-3.8 times as long as broad, with moderately sclerotized rimae. Anal lobes simple or grooved.

The egg of the Brazilian morphs has been studied in detail (Selivon & Perondini 1999, Selivon *et al.*, 2003). As in most species of the *fraterculus* species group, the eggs of species of the *fraterculus* complex are white, spindle-shaped, broad anteriorly, tapering posteriorly; with faint reticulation consisting primarily of irregular pentagons and hexagons. They can be distinguished from the egg of *A. obliqua* by the lack of a small lobe on the anterior end.

Adult

As is the case for other *Anastrepha* species, the adults of the *fraterculus* complex are easily separated from other tephritids by a simple wing venation character; vein M_1, the longitudinal vein that reaches the wing margin just behind the wing apex, curves strongly forward before meeting the costa on the wing margin without a visible angle. Furthermore, like most *Anastrepha* species, species of the *fraterculus* complex have a characteristic wing pattern composed of 3 orange and brown bands: the ‘C-band’ on the anterior margin from the base to near midlength; the ‘S-band’, a sideways S-shaped band from the wing base, curving forward across the middle of the wing (in *A. ludens* narrowly connected to the C-band, but with a triangular marginal hyaline area between them), then running along the anterior margin to the wing apex; and the ‘V-band’, an inverted V-shaped band on the posterior apical half of the wing.

Identification to species level is very difficult as there are several extremely similar species; if necessary, specimens should be referred to a specialist. It is essential to examine the aculeus (which is usually inside the oviscape, the basal tubelike part of the ovipositor) of a female specimen to achieve positive identification. The only comprehensive identification tool for *Anastrepha* is the online key by Norrbom *et al*. (2012). Adults of the *fraterculus* complex can be distinguished from those of other species of *Anastrepha* by the following combination of characters: Setae red brown to dark red brown; thorax dorsally without brown markings except usually with a medial brown spot on scuto-scutellar suture, Brazil-1 morph often with pair of irregular brown marks posterolaterally on scutum; scutellum entirely white or yellow except extreme base; subscutellum (lens-shaped sclerite below scutellum) orange medially, dark brown laterally; mediotergite brown laterally, orange medially; wing with C-band orange posterior to pterostigma except narrowly on distal margin in cells r_1 and r_{2+3}; C-band and S-band connected or separated; oviscape (in female) entirely yellow to orange brown, 1.65-2.15 mm long, 0.55–0.75 times mesonotum length; aculeus 1.40-2.06 mm long; aculeus tip 0.20–0.30 mm long, 0.12-0.15 mm wide; gradually tapering, but with medial constriction; distal 0.47–0.65 serrate; lateral margins not curved dorsally; phallus (in male) 2.6–3.45 mm long, 0.9–1.1 times mesonotum length.

Molecular

The *fraterculus* complex generally cannot be distinguished from many of the other species of *Anastrepha fraterculus* species group based on differences in the DNA barcode region of the cytochrome oxidase I gene, although the Mexican morph differs from the other morphs but not *A. suspensa* (Barr *et al*., 2017). The nuclear ribosomal internal transcribed spacer 1 (ITS1) has been found to distinguish most of the morphs within the complex, with the exception of the Andean and Ecuadorian morphs, and the lowland Venezuelan and Mexican morphs (Sutton *et al.*, 2015, Prezotto *et al*., 2019).

Detection and inspection methods

No specialized male lures are so far commercially available for *Anastrepha* species. Monitoring for adults utilizes traps with protein-based or other ammonia-emitting lures, which are much less effective than the male lures used for various dacine fruit flies. McPhail traps baited with torula yeast, hydrolyzed protein, or other fermenting protein lures, or Multilure traps baited with ammonium acetate and putrescine are typically used for the capture of *Anastrepha* species (Thomas *et al*., 2001; Adaime *et al*., 2011).

PATHWAYS FOR MOVEMENT

Adults of *A. fraterculus* have not been reported to disperse over long distances, but natural movement of adults is still an important means of spread.

For the EPPO region, the most important fruits liable to carry *A. fraterculus* are *Psidium guajava* and other cultivated Myrtaceae, and to a lesser extent *Citrus* spp., *Malus domestica*, *Prunus* spp., and *Mangifera indica*. There is also a risk from the transport of puparia in soil or packaging with plants which have already fruited.

PEST SIGNIFICANCE

Economic impact

Anastrepha species are the most serious fruit fly pests in the tropical Americas (Enkerlin *et al.*, 1989, Norrbom & Foote 1989), along with the introduced *Ceratitis capitata* and *Bactrocera carambolae*. The Andean/Ecuadorian, Brazil-1, and Peruvian morphs of the *fraterculus* complex are among the most significant fruit fly pests in the areas where they occur, particularly in the Andean countries, Southern Brazil, Northern Argentina, Uruguay and Paraguay, whereas in other areas the pest status of the other morphs is less significant or not well studied (Enkerlin *et al*. 1989, Salles, 1995, Molineros *et al*., 1992, Rodríguez & Arévalo, 2015).

Control

Bait sprays, typically a mixture of Spinosad, malathion, or other insecticides and a food-based attractant, such as hydrolyzed yeast, are the most common type of chemical control for *Anastrepha* species (Bateman, 1982, Roessler, 1989). The toxicity to *A. fraterculus* (presumably Brazil-1 morph) of different insecticides used in baits was compared by Salles (1995). Cultural practices, such as destroying all fallen and infested fruits, are also used. Biological control with braconid wasps has been tested in Argentina (Ovruski & Schliserman, 2012), and research has been conducted towards mass rearing and implementation of a sterile insect technique (SIT) program against *A. fraterculus* in several countries, but especially Argentina (Cladera *et al.*, 2014).

Phytosanitary risk

The *fraterculus* complex has a broad range of hosts and at least three of the morphs (Andean/Ecuadorean, Brazil-1, and Peruvian) are major pests where they occur. The Andean/Ecuadorian and Brazil-1 morphs in particular occur in more temperate areas (higher altitude or lower latitude) of South America than most other *Anastrepha* species, thus may pose a higher risk of establishment in other subtropical areas of the world. The Peruvian morph occurs in dry inter-Andean valleys and river valleys within the Peruvian desert, thus may be more of a threat to arid subtropical regions. The Brazil-1 morph is invasive at least in Bolivia and Peru, and the Peruvian morph is invasive in the Galapagos Islands. *Anastrepha* species are not thought to be capable of surviving the cold winters of the northern and central part of the EPPO region, thus the risk of establishment of the *fraterculus* complex is limited to the warmer southern parts of the EPPO region. The major risk for EPPO countries may be the probable imposition of stricter phytosanitary restrictions on exported fruits (particularly to America and Japan) if any species of the *fraterculus* complex enters and multiplies, even temporarily.

PHYTOSANITARY MEASURES

Consignments of fruits of *Annona*, *Citrus*, *Fortunella*, *Malus*, *Mangifera indica*, *Prunus domestica*, *Prunus persica* and *Psidium guajava* from countries where the *A. fraterculus* complex 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 the *fraterculus* complex 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 or, for certain types of fruits, by vapour heat or hot water immersion (USDA, 2021). Dias *et al.* (2020) tested the response of three morphs to cold treatment and concluded that current approved cold treatments will work for all morphs of the complex. Ethylene dibromide was previously widely used as a fumigant but is now generally withdrawn because of its carcinogenicity; methyl bromide is approved on a very limited basis (e.g., USDA approves use for Mexican clementines, grapefruit and oranges for *Anastrepha* spp. (T101-j-2-1); for blueberries for *A. fraterculus* (T101-i-1-1 and T101-i-1-2); and for kumquats for *A. fraterculus* (T101-n-3)) (USDA, 2021). Irradiation at 70 gy is considered effective treatment for immature stages (USDA, 2021).

Plants of host species transported with roots from countries where the *A. fraterculus* complex occurs should be free from soil, or the soil should be treated to kill any puparia.

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