EPPO Datasheet: *Anastrepha ludens*

Last updated: 2021-01-08

IDENTITY

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Preferred name: *Anastrepha ludens*
Authority: (Loew)
Taxonomic position: Animalia: Arthropoda: Hexapoda: Insecta: Diptera: Tephritidae
Other scientific names: *Acrotoxa ludens* Loew, *Anastrepha lathana* Stone, *Trypeta ludens* (Loew)
Common names: Mexican fruit fly
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EPPO Categorization: A1 list
view more categorizations online...
EU Categorization: A1 Quarantine pest (Annex II A)
EPPO Code: ANSTLU

Notes on taxonomy and nomenclature

This species was first described in 1873 by Loew as *Trypeta ludens*. The current combination was proposed by Wulp (1900). The name *Anastrepha lathana* Stone is considered a synonym. Name, host plant, and distribution data for this species and other fruit flies are available under Fruit Fly Databases on the USDA Compendium of Fruit Fly Host Information.

HOSTS

Mango (*Mangifera indica*) and various species of *Citrus*, especially grapefruit and oranges, are the most important commercial hosts (Hernandez-Ortiz, 1992) of *A. ludens*. Peach (*Prunus persica*) and various other fruit crops are attacked less frequently, but more than 40 plant species are reported as at least occasional field hosts of this polyphagous pest (Norrbom, 2004). Thomas (2004) provides an example of *A. ludens* adaptive capability to infest new host plants, describing the discovery of the introduced manzano pepper (*Capsicum pubescens*) as an unexpected new host in Mexico. Nearly all of the commercial hosts of *A. ludens* are exotic. Baker *et al*. (1944) considered *Casimiroa greggii* (Rutaceae) to be the only native wild host, although three other *Casimiroa* spp. (Jirón *et al*., 1988) and several other wild native plants could also have been original hosts.

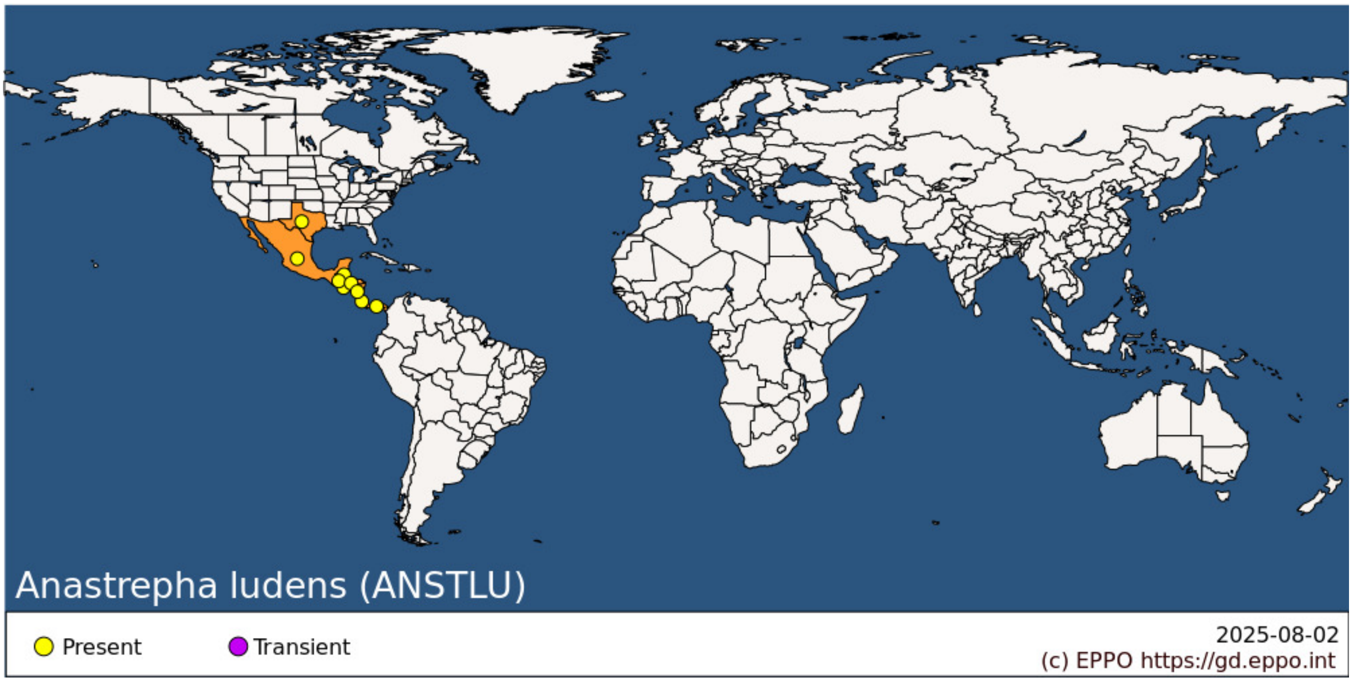
Host list: *Anacardium occidentale*, *Annona cherimola*, *Annona liebmanniana*, *Annona reticulata*, *Annona squamosa*, *Capsicum pubescens*, *Casimiroa edulis*, *Casimiroa greggii*, *Casimiroa pubescens*, *Casimiroa tetrameria*, *Citrus maxima*, *Citrus medica*, *Citrus reshni*, *Citrus reticulata*, *Citrus x aurantiifolia*, *Citrus x aurantium var. deliciosa*, *Citrus x aurantium var. paradisi*, *Citrus x aurantium var. sinensis*, *Citrus x aurantium*, *Citrus x limon var. limetta*, *Citrus x limon var. meyerii*, *Citrus x tangelo*, *Citrus*, *Coffea arabica*, *Cydonia oblonga*, *Diospyros kaki*, *Diospyros texana*, *Inga flexuosa*, *Inga jinicuil*, *Malus domestica*, *Mammea americana*, *Mangifera indica*, *Melicoccus oliviformis*, *Passiflora edulis*, *Persea americana*, *Prunus persica*, *Psidium cattleyanum*, *Psidium guajava*, *Psidium guineense*, *Psidium oligospermum*, *Punica granatum*, *Pyrus communis*, *Sideroxylon capiri subsp. tempisque*, *Spondias purpurea*, *Syzygium jambos*

GEOGRAPHICAL DISTRIBUTION

A. ludens occurs from Northeastern Mexico south to Panama. In Mexico there are fly free areas in Baja California and Northwestern Mexico (Ramírez y Ramírez *et al*., 2020). Frequent incursions are detected in the Rio Grande Valley of Texas in the USA and are subjected to eradication. Outbreaks have also occurred in California and less commonly in Arizona but have been eradicated (McCombs *et al*., 2010). *A. ludens* is occasionally trapped in other states of the USA (e.g., Florida) and in other countries, but it is not established there. The record of this species from

Colombia (Núñez Bueno, 1981) was based on misidentification of *Anastrepha manizaliensis* (Norrbom *et al*., 2005). There are no valid reports of *A. ludens* from Colombia.

Baker *et al*. (1944) considered this species to be native only to northeastern Mexico, but Jirón *et al*. (1988) and Ruiz-Arce *et al*. (2015) did not support that hypothesis, the latter finding higher genetic diversity in populations in southern Mexico and Central America. Dupuis *et al*. (2019) identified four populations (Western Mexico, Eastern Mexico, Guatemala/Belize/Honduras, and Costa Rica/Panama) but found significant intergradation and could not identify an ancestral range. *A. ludens* was rare in Costa Rica and was not a pest of citrus prior to the mid-1990s, when it suddenly became common in the central highlands and was found attacking orange and grapefruit, including at a research station where Jirón *et al*. (1988) had worked extensively and had not found it attacking these fruits. It has subsequently been detected in western and central Panama, where it is invasive. This suggests that there was an introduction of a northern population into Costa Rica leading to the spread of this species into Panama.



North America: Mexico, United States of America (Texas)
Central America and Caribbean: Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Panama

BIOLOGY

As in *Anastrepha* species generally, eggs are laid in the host fruit, in the case of *A. ludens* these are laid singly or in clutches of up to 40 eggs, with clutch size related to fruit size (Aluja *et al*., 1999). Development time for eggs has been reported as 3 days to as long as 6-12 days; larvae pass through three instars, with development time varying from 8–30 days depending on the host fruit and temperature and other environmental conditions (Birke *et al*., 2013). Larvae feed in the albedo or pulp of commercial fruits but can feed on the seeds of native *Casimiroa* hosts (Aluja *et al*. 1999). Mature larvae exit the fruit and pupariate in the soil. Adults emerge after 12 to 32 days, depending upon temperature (Birke *et al*., 2013). Adults can be long lived, up to a year under certain conditions, and occur throughout the year (Christenson & Foote, 1960, Aluja, 1994). Adult males produce a pheromone and lek to attract females for mating. Calling occurs in late afternoon, with mating at dusk (Aluja, 1994; Birke *et al*., 2013).

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, like those of most fruit flies, is extremely difficult. Larvae have been described for only 9% of the species of *Anastrepha* (Steck *et al*., 2019), but the third stage larva of *A. ludens* can usually be distinguished from those of most of the other economically important species of the genus using the key of Steck *et al*. (1990) or the interactive key of Carroll *et al*. (2004), which include 13 or 15 *Anastrepha* species, respectively. Carroll and Wharton (1989) provided a detailed description of the egg, larva (all 3 instars), and puparium, and Heppner (1984), and White and Elson-Harris (1992) also provided descriptions of the third instar.

As in other *Anastrepha* species, the larva is whitish, up to 11.1 mm in length, lacking an external head capsule. The two mandibles, or mouthhooks, are strongly developed and equal in size. The body is tapered anteriorly and truncate posteriorly. Posterior spiracular plate weak, unpigmented, without 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 and Wharton (1989) and White and Elson-Harris (1994): Length 5.8-11.1 mm; width 1.2-2.5 mm. Head: Stomal sensory organ large, rounded, with 5 small sensilla; 11-17 oral ridges with margins entire or slightly undulant; accessory plates small; mandible moderately sclerotized, with single large slender curved apical tooth. Thoracic and abdominal segments: T1-T3 middorsally with 4-6, 3-5, and 1-2 rows of spinules, respectively; A1-A8 without dorsal spinules medially; creeping welt on A1 with 7-9 rows of spinules, those on A2-A8 with 9-17 rows; A8 with intermediate lobes moderately developed; caudal segment with tubercles and sensilla small but obvious. Anterior spiracle with 12-21 tubules. Posterior spiracle with spiracular slits about 3.5 times as long as broad, with moderately sclerotised rimae; spiracular hairs short (about one-third to one-fifth length of spiracular slit), often branched on apical third; dorsal and ventral bundles of 6-13 hairs, lateral bundles of 4-7 hairs. Anal area with lobes large, protuberant, usually distinctly bifid; surrounded by 3-4 discontinuous rows of small spinules.

The egg is 1.37-1.60 mm long, at greatest width 0.18-0.21 mm; white, spindle-shaped, broad anteriorly, tapering posteriorly; micropyle slightly to one side of apex of anterior pole; faint reticulation near micropyle consisting primarily of irregular pentagons and hexagons, these becoming very faint and elongated on posterior portion of egg; distinct openings into chorion at vertices of polygons on anterior end (Carroll and Wharton, 1989).

Adult

Like other *Anastrepha* species, *A. ludens* is 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, *A. ludens* has 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 more difficult. 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 *A. ludens* 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; scutellum entirely white or yellow except extreme base; subscutellum (lens-shaped sclerite below scutellum) orange medially, dark brown laterally, brown markings often extending ventrally onto mediotergite; 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 usually connected, occasionally separated; oviscape (in female) entirely yellow to orange brown, 3.54–6.17 mm long, oviscape length/mesonotum length 1.1–1.55; aculeus length 3.37–5.76 mm; aculeus tip length 0.28–0.42 mm; phallus length 5.2–6.1 mm; phallus (in male) length/mesonotum length 1.51–1.81.

Molecular

A. ludens can be distinguished from other species of *Anastrepha* based on differences in the DNA barcode region of the cytochrome oxidase I gene (Barr *et al*., 2017). Ruiz-Arce *et al*. (2015) examined its genetic diversity and population structure using two mitochondrial genes (COI and ND6), and more recently Dupuis *et al*. (2019), using genomic data, analyzed its population structure and developed a set of diagnostic single nucleotide polymorphisms (SNPs) for source determination.

Detection and inspection methods

No specialized male lures are 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

Anastrepha adults are capable of long-distance dispersal, and adult *A. ludens* have been reported to fly as far as 135 km (Aluja, 1994). Natural movement is therefore an important means of spread.

In international trade, the major means of fruit fly dispersal to previously uninfested areas is via transport of fruit containing live eggs or larvae. For the EPPO region, the most important imported fruits liable to carry *A. ludens* are *Citrus* and *Mangifera indica*, and to a lesser extent various minor hosts. There is also a risk of the transport of fruit fly puparia in soil or packaging.

PEST SIGNIFICANCE

Economic impact

Anastrepha species are the most serious fruit fly pests in the tropical Americas (Norrbom & Foote, 1989), along with the introduced *Ceratitis capitata* and *Bactrocera carambolae*. *A. ludens* is considered the most important fruit fly pest in Mexico and Central America, especially on *Citrus* spp. and mango (Enkerlin *et al*., 1989).

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 *A. ludens* (Bateman, 1982; Roessler, 1989; McCombs *et al*., 2010). Cultural practices, such as destroying all fallen and infested fruits, are also used. Soil drenches around host plants with appropriate pesticides are used to kill larvae and pupae during eradication programs (Stark *et al*., 2014). Classical biological control was tried against *A. ludens* in Texas (USA), but introduced parasitoids had little impact (Wharton, 1989). However, *Diachasmimorpha longicaudata* (Braconidae) continues to be mass reared and released in Mexico (Ramírez y Ramírez *et al*., 2020). Sterile insect technique has been used effectively against *A. ludens* in southern Texas and northern Mexico for suppression and eradication (McCombs *et al*., 2010) and it is used in area-wide management programs to control *A. ludens* in Mexico, primarily in the north to maintain fly free areas (Ramírez y Ramírez *et al*., 2020).

Phytosanitary risk

A. ludens has a broad range of hosts and is a major pest throughout its range. It occurs in higher, more temperate areas of Central America and Mexico than most other *Anastrepha* species, thus it may pose a higher risk of establishment in other subtropical areas of the world than other species of *Anastrepha*. It is invasive at least in Panama and has been trapped in California and other states in the USA. *Anastrepha* species are not capable of surviving the cold winters of the northern and central part of the EPPO region, thus the risk of establishment of *A. ludens* is limited to the warmer southern parts of the EPPO region.

PHYTOSANITARY MEASURES

Consignments of fruits of *Annona*, *Citrus*, *Malus*, *Mangifera indica*, *Prunus domestica*, *Prunus persica* and *Psidium guajava* from countries where this pest occurs should be inspected for symptoms of infestation and those suspected should be cut open in order to look for larvae. Such fruits should come from an area where *A. ludens* 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., 18, 20 or 22 days at 0.5, 1 or 1.5°C, respectively) or, for certain types of fruits, by hot water treatment (for mango, 46°C for 65 to 110 minutes depending on fruit size) or by vapour heat (e.g., keeping at 43°C for 4-6 h) (USDA, 2020), or forced hot-air treatment (Mangan & Ingle, 1994). 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., 1 treatment schedule (T101-j-2-1; 40 g/m^3 for 2 h at 21-29.5°C) is currently approved by USDA (2020) to treat oranges, tangerines and grapefruit from Mexico under pre-clearance. Irradiation at 70 gy is considered effective treatment for immature stages of *A. ludens* (USDA, 2020).

Plants of host species transported with roots from countries where *A. ludens* occurs should be free from soil, or the soil should not contain fruits or seeds or be treated to kill any puparia.

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Datasheet history

This datasheet was first published in the EPPO Bulletin in 1983, revised in the two editions of 'Quarantine Pests for Europe' in 1992 and 1997, as well as 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 (1^{st} and 2^{nd} edition)*. CABI, Wallingford (GB).

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