Data Sheets on Quarantine Pests

Anastrepha ludens

IDENTITY

Name: *Anastrepha ludens* (Loew)
Synonyms: *Acrotoxa ludens* Loew
Trypeta ludens (Loew)
Taxonomic position: Insecta: Diptera: Tephritidae
Common names: Mexican fruit fly (English)
Mouche mexicaine des fruits (French)
Mosca mexicana de la fruta (Spanish)
Bayer computer code: ANSTLU
EPPO A1 list: No. 230
EU Annex designation: I/A1

HOSTS

The native wild host of *A. ludens* in its area of origin in northeastern Mexico is *Sargentia greggii* (Rutaceae). *Citrus* spp. are the most important introduced hosts, and also mangoes (*Mangifera indica*), on which the pest has spread southwards through Mexico (Hernandez-Ortiz, 1992). Myrtaceae (e.g. *Psidium guajava* - guavas) and Rosaceae (e.g. *Prunus persica* - peaches) are only occasional hosts. Like other *Anastrepha* spp., *A. ludens* has been recorded incidentally on a wider range of fruits, both tropical and temperate, but these records are incidental occurrences, of no economic significance.

GEOGRAPHICAL DISTRIBUTION

EPPO region: Absent.
North America: Mexico, USA (Texas; found but not established in Arizona and California; intercepted in Florida).
Central America and Caribbean: Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua.
South America: Argentina, Colombia.
EU: Absent.
Distribution map: See CIE (1958, No. 89).

BIOLOGY

As in *Anastrepha* spp. generally, eggs are laid below the skin of the host fruit (and probably adjacent to the nut, seeds or stone since this species has a long ovipositor). They hatch within 6-12 days and the larvae feed for another 15-32 days at 25°C. Pupariation is in the soil under the host plant and adults emerge after 15-19 days (longer in cool conditions); adults occur throughout the year (Christenson & Foote, 1960).

DETECTION AND IDENTIFICATION

Symptoms

Attacked fruit can show signs of oviposition punctures, but these, or any other symptoms of damage, are often difficult to detect in the early stages of infestation. Much damage may occur inside the fruit before external symptoms are seen, often as networks of tunnels accompanied by rotting.

Morphology

Larva

In general it is not possible to identify *Anastrepha* spp. with certainty from larval characteristics. Descriptions of the larva of *A. ludens* are provided by Berg (1979), Heppner (1984), Carroll & Wharton (1989), Steck *et al*. (1990) and White & Elson-Harris (1992). As in other *Anastrepha* spp., the larva is whitish, up to 12 mm in length, usually feeding in the flesh of the fruits. The two mouth hooks are strongly developed and equal in size. The body is tapered anteriorly and truncated at the posterior end. Each posterior spiracle has three openings or slits arranged parallel or converging, on a sclerotized plate. The larva of *A. ludens* can be separated from those of *A. fraterculus* and *A. obliqua* by having more than twelve buccal carinae (compared to usually eight or nine in the other two species) and by having the caudal papillae, above and below the posterior spiracles, arranged in two lines, rather than a single line.

Adult

A. ludens, like other *Anastrepha* spp., is easily separated from other tephritids by a simple wing venation character; the vein that reaches the wing margin just behind the wing apex curves forwards before joining the wing margin. Furthermore, most *Anastrepha* spp. have a very characteristic wing pattern; the apical half of the wing has two inverted 'V'-shaped markings, one fitting within the other; and a stripe along the forward edge of the wing which runs from near the wing base to about half-way along the wing length.

Identification to species is more difficult. In particular, it is essential to dissect the aculeus (ovipositor piercer) of a female specimen to achieve positive identification. Colour: scutum without any silvery or hoary patterning; mediotergite entirely orange; postnotum orange medially, and dark-brown laterally; wing pattern pale yellow-brown; apical section of vein M (beyond dm-cu crossvein) crossed by an oblique marking; in cell r4+5 this marking often joins the marking on crossvein dm-cu to form an inverted V-shaped band (the V-band); patterned areas covering cells sc and the r-m crossvein, separate, or joined along vein R4+5, but never through the whole depth of cell r2+3. Abdomen: aculeus tip serrate (in the apical half of the tip only) and less than 0.18 mm wide; aculeus very long, 3.3-4.7 mm. Wing length 7-9 mm.

Detection and inspection methods

No male lures have yet been identified for *Anastrepha* spp. However, they are captured by traps emitting ammonia and it is likely that traps already set for *Rhagoletis cerasi* in the cherry-growing areas of the EPPO region may attract *Anastrepha* spp. if they should ever occur in those areas. McPhail traps are usually used for the capture of *Anastrepha* spp. (see Drew, 1982 for trap details) and possible baits are ammonium acetate (Hedstrom & Jimenez, 1988), casein hydrolysate (Sharp, 1987) and torula yeast (Hedstrom & Jiron, 1985). The number of traps required per unit area is high; in a release and recapture test Calkins *et al*. (1984) placed 18 traps per 0.4 ha and only recovered about 13% of the released flies.

MEANS OF MOVEMENT AND DISPERSAL

There is evidence that adults of *Anastrepha* spp. can fly for as far as 135 km (Fletcher, 1989) and therefore natural movement is an important means of spread.

In international trade, the major means of dispersal to previously uninfested areas is the transport of fruit containing live larvae. For the EPPO region, the most important fruits liable to carry *A. ludens* are *Citrus* and *Mangifera indica*, and to a lesser extent *Prunus persica* and *Psidium guajava*. The various tropical fruit hosts which may be locally important in America are little traded to Europe. 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 spp. are the most serious fruit fly pests in the tropical Americas (Norrbom & Foote, 1989), with the possible exception of the introduced *Ceratitis capitata* (EPPO/CABI, 1996). *A. ludens* is mainly important on *Citrus* spp. and mangoes. It is the most abundant fruit fly in some areas of Guatemala (Eskafi, 1988) and Mexico (Malo *et al*., 1987).

Control

Control can be considerably aided by good cultural practices, for example by gathering all fallen and infected host fruits, and destroying them. 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 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 *A. ludens*, but introduced parasitoids have had little impact (Wharton, 1989). Sterile insect release has been tried against *A. ludens* (Gilmore, 1989) but no major control programme has been carried out.

Phytosanitary risk

A. ludens is considered as an EPPO A1 quarantine pest within the broad category "non-European Trypetidae" (OEPP/EPPO, 1983). It is also of quarantine significance for COSAVE.

A. ludens, like other *Anastrepha* spp., derives from tropical wet forest habitats; the northern and central part of the EPPO region would not have sufficiently high temperatures for its survival, whereas most of the warmer southern parts of the EPPO region would probably be too arid for it to become widely established. Thus, the direct risk of establishment of *A. ludens* in most of the EPPO region is minimal, though populations might enter and multiply during the summer months. In southern areas, some such populations might survive one or several winters, though in any case the direct losses from such introductions would probably not be high. The major risk for EPPO countries arises from the probable imposition of much stricter phytosanitary restrictions on exported fruits (particularly to America and Japan) if any *Anastrepha* sp. 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 pest occurs should be inspected for symptoms of infestation and those suspected should be cut open in order to look for larvae. EPPO recommends (OEPP/EPPO, 1990) that such fruits should come from an area where the *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 vapour heat (e.g. keeping at 43°C for 4-6 h) (USDA, 1994), 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 less satisfactory, damaging many fruits and reducing their shelf life, but treatment schedules are available (e.g. 40 g/m^3 for 2 h at 21-29.5°C; USDA, 1994).

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

BIBLIOGRAPHY

Bateman, M.A. (1982) Chemical methods for suppression or eradication of fruit fly populations. In: *Economic fruit flies of the South Pacific Region* (Ed. by Drew, R.A.I.; Hooper, G.H.S.; Bateman, M.A.) (2nd edition), pp. 115-128. Queensland Department of Primary Industries, Brisbane, Australia.

Berg, G.H. (1979) *Pictorial key to fruit fly larvae of the family Tephritidae*, 36 pp. Organismo Internacional Regional de Sanidad Agropecuaria, San Salvador, El Salvador.

Calkins, C.O.; Schroeder, W.J.; Chambers, D.L. (1984) Probability of detecting Caribbean fruit fly, *Anastrepha suspensa* (Loew) (Diptera: Tephritidae), populations with McPhail traps. *Journal of Economic Entomology* **77**, 198-201.

Carroll, L.E.; Wharton, R.A. (1989) Morphology of the immature stages of *Anastrepha ludens* (Diptera: Tephritidae). *Annals of the Entomological Society of America* **82**, 201-214.

Christenson, L.D.; Foote, R.H. (1960) Biology of fruit flies. *Annual Review of Entomology* **5**, 171-192.

CIE (1958b) *Distribution Maps of Insect Pests, Series A* No. 89. CAB International, Wallingford, UK.

Drew, R.A.I. (1982) Fruit fly collecting. In: *Economic fruit flies of the South Pacific Region* (Ed. by Drew, R.A.I.; Hooper, G.H.S.; Bateman, M.A.) (2nd edition), pp. 129-139. Queensland Department of Primary Industries, Brisbane, Australia.

EPPO/CABI (1996) *Ceratitis capitata*. In: *Quarantine pests for Europe*. 2nd edition (Ed. by Smith, I.M.; McNamara, D.G.; Scott, P.R.; Holderness, M.). CAB INTERNATIONAL, Wallingford, UK.

Eskafi, F.M. (1988) Infestation of citrus by *Anastrepha* spp. and *Ceratitis capitata* in high coastal plains of Guatemala. *Environmental Entomology* **17**, 52-58.

Fletcher, B.S. (1989) Ecology; movements of tephritid fruit flies. In: *World Crop Pests 3(B). Fruit flies; their biology, natural enemies and control* (Ed. by Robinson, A.S.; Hooper, G.), pp. 209-219. Elsevier, Amsterdam, Netherlands.

Gilmore, J.E. (1989) Control; sterile insect technique (SIT); overview. In: *World Crop Pests 3(B). Fruit flies; their biology, natural enemies and control* (Ed. by Robinson, A.S.; Hooper, G.), pp. 353-363. Elsevier, Amsterdam, Netherlands.

Hedstrom, I.; Jimenez, J. (1988) [Field evaluation of attractants in the capture of *Anastrepha* spp. (Diptera, Tephritidae), pests of fruit trees in tropical America. II. Ammonium acetate and torula with sodium borate]. *Revista Brasileira de Entomologia* **32**, 319-322.

Hedstrom, I.; Jiron, L.F. (1985) [Field evaluation of attractants in the capture of *Anastrepha* spp. (Diptera, Tephritidae), pests of fruit trees in tropical America. I. Molasses and torula yeast]. *Revista Brasileira de Entomologia* **29**, 515-520.

Heppner, J.B. (1984) Larvae of fruit flies. I. *Anastrepha ludens* (Mexican fruit fly) and *Anastrepha suspensa* (Caribbean fruit fly) (Diptera: Tephritidae). *Entomology Circular, Division of Plant Industry, Florida Department of Agricultural and Consumer Services* No. 260.

Hernandez-Ortiz, V. (1992) El género *Anastrepha* en México. Taxonomía, distribución y sus plantas huéspedes. Instituto de Ecología, Xalapa, Mexico.

Malo, E.; Baker, P.S.; Valenzuela, J. (1987) The abundance of species of *Anastrepha* in the coffee producing area of coastal Chiapas, southern Mexico. *Folia Entomologica Mexicana* No. 73, 125-140.

Mangan, R.L.; Ingle, S.J. (1994) Forced hot-air quarantine treatment for grapefruit infested with Mexican fruit fly. *Journal of Economic Entomology* **87**, 1574-1579.

Norrbom, A.L.; Foote, R.H. (1989) Taxonomy and zoogeography; the taxonomy and zoogeography of the genus *Anastrepha* (Diptera: Tephritidae). In: *World Crop Pests 3(A). Fruit flies; their biology, natural enemies and control* (Ed. by Robinson, A.S.; Hooper, G.), pp. 15-26. Elsevier, Amsterdam, Netherlands.

OEPP/EPPO (1983) Data sheets on quarantine organisms No. 41, Trypetidae (non-European). *Bulletin OEPP/EPPO Bulletin* **13**, (1).

OEPP/EPPO (1990) Specific quarantine requirements. *EPPO Technical Documents* No. 1008.

Roessler, Y. (1989) Control; insecticides; insecticidal bait and cover sprays. In: *World Crop Pests 3(B). Fruit flies; their biology, natural enemies and control* (Ed. by Robinson, A.S.; Hooper, G.), pp. 329-336. Elsevier, Amsterdam, Netherlands.

Sharp, J.L. (1987) Laboratory and field experiments to improve enzymatic casein hydrolysate as an arrestant and attractant for Caribbean fruit fly, *Anastrepha suspensa* (Diptera: Tephritidae). *Florida Entomologist* **70**, 225-233.

Steck, G.J.; Carroll, L.E.; Celedonio-Hurtado, H.; Guillen-Aguilar, J. (1990) Methods for identification of *Anastrepha* larvae (Diptera: Tephritidae), and key to 13 species. *Proceedings of the Entomological Society of Washington* **92**, 333-346.

USDA (1994) *Treatment manual*. USDA/APHIS, Frederick, USA.

Wharton, R.H. (1989) Control; classical biological control of fruit-infesting Tephritidae. In: *World Crop Pests 3(B). Fruit flies; their biology, natural enemies and control* (Ed. by Robinson, A.S.; Hooper, G.), pp. 303-313. Elsevier, Amsterdam, Netherlands.

White, I.M.; Elson-Harris, M.M. (1992) *Fruit flies of economic significance, their identification and bionomics*. CAB International, Wallingford, UK.