Data Sheets on Quarantine Pests

Ceratitis capitata

IDENTITY

Name: *Ceratitis capitata* (Wiedemann)
Synonyms: *Ceratitis citriperda* MacLeay
Ceratitis hispanica De Brême
Pardalaspis asparagi Bezzi
Tephritis capitata Wiedemann
Taxonomic position: Insecta: Diptera: Tephritidae
Common names: Mediterranean fruit fly, medfly (English)
Mouche méditerranéenne des fruits, mouche de l'oranger, mouche des fruits (French)
Mittelmeerfruchtfliege (German)
Mosca mediterránea, moscamed (Spanish)
Bayer computer code: CERTCA
EPPO A2 list: No. 105

HOSTS

C. capitata is a highly polyphagous species whose larvae develop in a very wide range of unrelated fruits. On Hawaii (USA), 60 out of 196 fruit species examined over the years 1949-85 were at least once found as hosts of *C. capitata*; the two most important hosts were coffee (*Coffea arabica*) and *Solanum pseudocapsicum* (Liquido *et al.*, 1989). In the EPPO region, important hosts include apples (*Malus pumila*), avocados (*Persea americana*), *Citrus*, figs (*Ficus carica*), kiwifruits (*Actinidia deliciosa*), mangoes (*Mangifera indica*), medlars (*Mespilus germanica*), pears (*Pyrus communis*), *Prunus* spp. (especially peaches, *P. persica*), in fact practically all the tree fruit crops. It has also been recorded from wild hosts belonging to a large number of families.

GEOGRAPHICAL DISTRIBUTION

C. capitata originates in tropical Africa, from where it has spread to the Mediterranean area and to parts of Central and South America.
EPPO region: Southern part of the EPPO region, i.e. Albania, Algeria, Croatia (Kovacevic, 1965), Cyprus, Egypt, France (very limited distribution in south only; Cayol & Causse, 1993), Greece (including Crete), Hungary (found but not established), Israel, Italy, Lebanon, Libya, Malta, Morocco, Portugal (including Azores and Madeira), Russia (southern, found but not established), Slovenia, Spain (including Balearic and Canary Islands), Switzerland (limited distribution), Syria, Tunisia, Turkey, Ukraine (outbreaks in the south eradicated). Records in northern or central Europe (Austria, Belgium, Bulgaria, Czech Republic, Germany, Hungary, Luxemburg, Netherland, Sweden, UK) refer to interceptions or short-lived adventive populations only (Karpati, 1983; Fischer-Colbrie & Busch-Petersen, 1989).

Asia: Afghanistan (unconfirmed), Cyprus, India (single quarantine interception; Kapoor, 1989), Israel, Jordan, Lebanon, Saudi Arabia, Syria, Turkey, Yemen.
Africa: Algeria, Angola, Benin, Burkina Faso, Burundi, Botswana, Cameroon, Cape Verde Islands, Congo, Côte d'Ivoire, Egypt, Ethiopia, Gabon, Ghana, Guinea, Kenya, Liberia, Libya, Madagascar (also the related species *C. malgassa*), Malawi, Mali, Mauritius, Morocco, Mozambique, Niger, Nigeria, Réunion, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, South Africa, St. Helena, Sudan, Tanzania, Togo, Tunisia, Uganda, Zaire, Zimbabwe. Karpati (1983) lists some other African countries but does not give the source of his data.
North America: Bermuda (eradicated). USA (only Hawaii); introduced and eradicated several times in California during 1980s and 1990s; introduced, eradicated and still absent in Florida and Texas (Cunningham, 1989b; Lorraine & Chambers, 1989). Eradicated from Mexico.
Central America and Caribbean: Belize (eradicated), Costa Rica, El Salvador, Guatemala, Honduras, Jamaica, Netherlands Antilles, Nicaragua, Panama. The related species *C. malgassa*, from Madagascar, was at one time established in Puerto Rico (Steyskal, 1982).
South America: Argentina (locally), Bolivia, Brazil (Espirito Santo, Goias, Minas Gerais, Paraná, Rio Grande do Sul, São Paulo), Chile (extreme north only, declared eradicated in 1996), Colombia, Ecuador, Paraguay, Peru, Suriname, Uruguay, Venezuela.
Oceania: Australia (found but not established in New South Wales, limited distribution in Western Australia), Northern Mariana Islands.
EU: Present.
Distribution map: See CIE (1988, No. 1). González (1978) maps the history of introduction and eradication in the New World.

BIOLOGY

Eggs of *C. capitata* are laid below the skin of the host fruit. They hatch within 2-4 days (up to 16-18 days in cool weather) and the larvae feed for another 6-11 days (at 13-28°C). Pupariation is in the soil under the host plant and adults emerge after 6-11 days (24-26°C; longer in cool conditions) and adults live for up to 2 months (field-caged) (Christenson & Foote, 1960). *C. capitata* will not in practice survive sub-zero winter temperatures; it is well named Mediterranean, for the area in which it survives in the EPPO region is precisely that (virtually coinciding with where *Citrus* is grown). Worner (1988) uses the climate-matching system to evaluate the areas of potential establishment of *C. capitata* in New Zealand.

DETECTION AND IDENTIFICATION

Symptoms
Attacked fruit usually shows signs of oviposition punctures.

Morphology
C. capitata, like other *Ceratitis* spp., has banded wings, and a swollen scutellum which is marked yellow and black. The pattern of grey flecks in the basal wing cells distinguishes *Ceratitis* spp. from most other genera of tephritids. 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 Hardy (1949), Orian & Moutia (1960), Sabatino (1974), Berg (1979), Heppner (1985), Smith (1989), White & Elson-Harris (1992). Electrophoretic methods have been tried out to distinguish larvae of *B. tryoni* from those of *C. capitata* (Dadour *et al.*, 1992).

Adult

Colour: Wing bands and general body colour yellow; scutellum entirely black in apical half, with a sinuate yellow line across it sub-basally; costal band starting beyond the endof vein R1, and separated from discal crossband by a hyaline area at the end of R1.

Head: Male anterior pair of orbital setae modified into spatulate appendages, with a sharp apex to the spatulate section, which is black.

Thorax: Male mid-tibia without stout setae arranged in such a way as to give a feathered appearance. Wing length 4-6 mm.

Fortunately the males of this most serious of tephritid pests have a unique feature. The head of the male bears a pair of spatulate appendages which have sharp-pointed ends and the colour of the spatulate sections is black. Related species in subgenus *Ceratitis*, such as *C. malgassa*, have blunt spatulate appendages with a white spatulate section. The males also lack the feathered mid-tibia that characterizes most species of subgenus *Pterandrus*.

Detection and inspection methods

C. capitata can be monitored by traps baited with male lures. As in other tested species belonging to the subgenus *Ceratitis*, males are attracted to trimedlure and terpinyl acetate, but not methyl eugenol. Ceralure is a new potent and persistent attractant for *C. capitata* (Avery *et al.*, 1994). The responses to baits of 16 *Ceratitis* species were tabulated by Hancock (1987). Trimedlure (t-butyl-4(or 5)-chloro-2-methyl cyclohexane carboxylate) is the most widely used lure for *C. capitata*. The history of trimedlure development and the problems of isolating the best of the eight possible isomers are discussed by Cunningham (1989a). The lure is usually placed on a cottonwool 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 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 a few weeks. A review of the biological aspects of male lures is 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 *C. capitata* into New Zealand has been described by Somerfield (1989).

MEANS OF MOVEMENT AND DISPERSAL

Adult flight and the transport of infested fruits are the major means of movement and dispersal to previously uninfested areas. There is evidence that *C. capitata* can fly at least 20 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

C. capitata is an important pest in Africa and has spread to almost every other continent to become the single most important pest species in the family. It is highly polyphagous and

causes damage to a very wide range of unrelated fruit crops. In Mediterranean countries, it is particularly damaging on citrus and peaches. It also transmits fruit-rotting fungi (Cayol *et al*., 1994).

Control

When detected, it is important to gather all fallen and infected host fruits, and destroy them. Traps containing male lures should be used to monitor population size and spread continuously (Niccoli *et al.*, 1991). Insecticidal protection is possible by using a cover spray or a bait spray (Stancic, 1986; Roessler & Chen, 1994). 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 *C. capitata*, but introduced parasitoids have had little impact (Wharton, 1989). The techniques of male annihilation and sterile insect release have been used against some populations of *C. capitata*. Male annihilation utilizes the attraction of males to chemical lures and this technique has been applied in Hawaii where it did have some impact on population size (Cunningham, 1989c). The sterile insect technique (SIT) requires 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). SIT has been used against *C. capitata* in Costa Rica, Italy, Mexico, Nicaragua, Peru, Spain, Tunisia and the USA (California, Hawaii) (Gilmore, 1989). The largest of these programmes (Programa Moscamed) is being carried out in southern Mexico and is designed to stop the fly spreading north, and ultimately to eradicate it from Central America (Schwarz *et al*., 1989). SIT depends on the ability to mass-rear millions of sterile flies and Vargas (1989) reviews the required procedures. Control methods and their application in the USA are reviewed by Mitchell & Saul (1990), while the actions taken since 1975 in California are reviewed by Carey (1992).

Phytosanitary risk

C. capitata is an EPPO A2 quarantine pest (OEPP/EPPO, 1981), and is also of quarantine significance throughout the world (CPPC, NAPPO, APPPC) and especially for Japan and the USA. Its presence in Hawaii, but not in mainland USA, has contributed to its high international profile as a quarantine pest. In the EPPO region, *C. capitata* has reached the limits of its natural distribution and does not appear likely to establish in any major new areas (but possibly around the Black Sea). However, its presence even as temporary adventive populations could lead to severe additional constraints for export of fruits to uninfested areas in other continents. In this respect, *C. capitata* is one of the most significant quarantine pests for the EPPO region.

PHYTOSANITARY MEASURES

Consignments of fruits from countries where *C. capitata* 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 fruits of *Citrus* or *Prunus* should have been treated by an appropriate method, e.g. in transit by cold treatment (e.g. 10, 11, 12, 14, 15 days at 0.0, 0.6, 1.1, 1.7 or 2.2°C, respectively,) or, for certain types of fruits, by vapour heat (e.g. keeping at 44°C for 8 h) (USDA, 1994), forced hot-air (Armstrong *et al*., 1995) or hot water treatment (Sharp & Picho-Martinez, 1989). 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. 32 g/m^3 for 2-4 h; USDA, 1994). Irradiation has been proposed as disinfestation method (Ohta *et al*., 1989). A combination of methyl bromide fumigation and cold treatment is also recommended against *C. capitata*. Wrapping fruits in shrinkwrap film has been investigated as a possible method of disinfesting fruits (Jang, 1990).

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