EPPO Datasheet: *Frankliniella occidentalis*

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IDENTITY

Preferred name: *Frankliniella occidentalis*
Authority: (Pergande)
Taxonomic position: Animalia: Arthropoda: Hexapoda: Insecta: Thysanoptera: Thripidae
Other scientific names: *Frankliniella californica* (Moulton), *Frankliniella helianthi* (Moulton), *Frankliniella moultoni* Hood, *Frankliniella trehernei* Morgan
Common names: alfalfa thrips, western flower thrips (US), western grass thrips
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EPPO Categorization: A2 list
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EPPO Code: FRANOC



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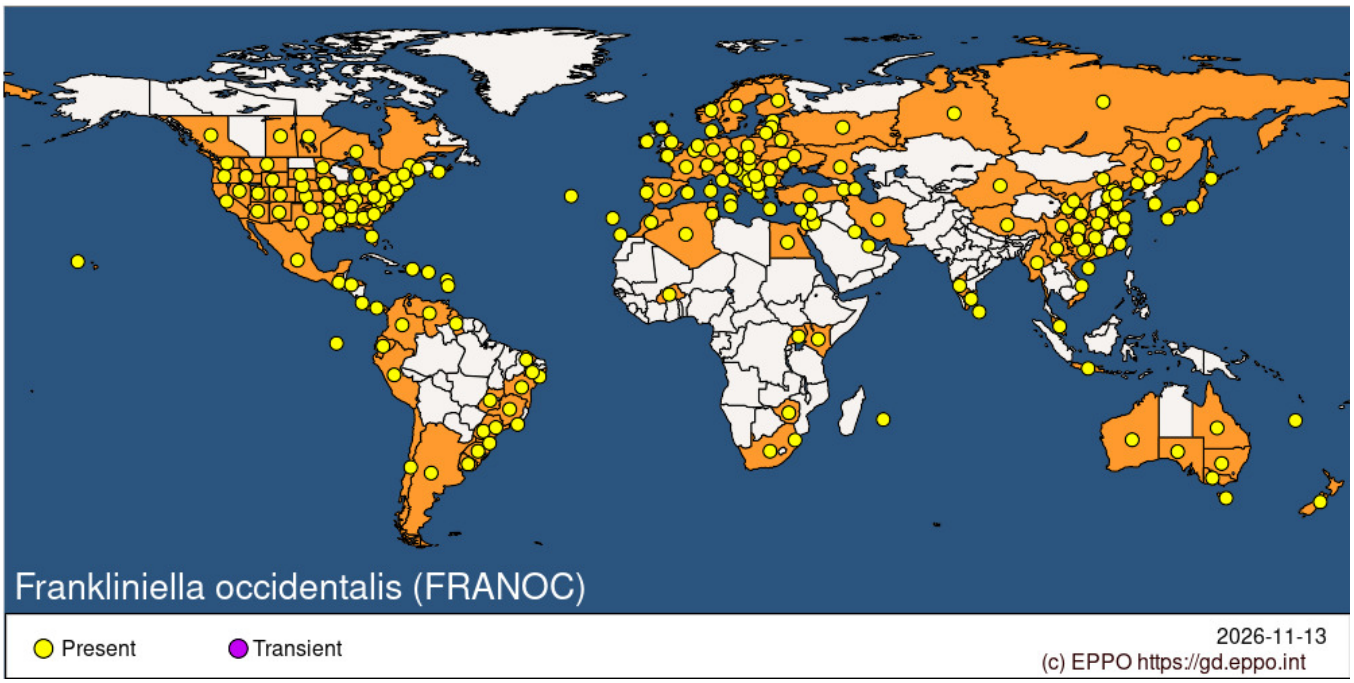
HOSTS

F. occidentalis is a remarkably polyphagous species with 244 plant species from 62 families being recorded as hosts. In the USA, the pest is found outdoors attacking the flowers of apricots, peaches and nectarines, plums, roses, carnations, sweet peas, *Gladiolus*, peas, tomatoes, *Capsicum*, Cucurbitaceae and strawberries. Other hosts in the USA include: *Beta*, carrots, cotton, grapefruits, grapes, onions, *Phaseolus*, *Purshia tridentata*, safflower. In Europe it is generally found only on glasshouse crops on an ever-increasing range of host plants, but most commonly on chrysanthemums, *Gerbera*, roses and *Saintpaulia*.

Host list: *Allium cepa*, *Allium*, *Amaranthus hybridus*, *Amaranthus spinosus*, *Beta vulgaris*, *Capsicum annuum*, *Carthamus tinctorius*, *Chenopodium quinoa*, *Chrysanthemum x morifolium*, *Citrus x aurantium var. paradisi*, *Citrus x latifolia*, *Cucumis sativus*, *Cucurbita pepo*, *Cucurbitaceae*, *Daucus carota subsp. sativus*, *Dianthus caryophyllus*, *Diospyros kaki*, *Erythrina variegata*, *Fragaria x ananassa*, *Gardenia jasminoides*, *Gerbera jamesonii*, *Gladiolus hybrids*, *Gossypium hirsutum*, *Helianthus annuus*, *Lathyrus odoratus*, *Mangifera indica*, *Medicago sativa*, *Melampodium divaricatum*, *Mentha x piperita*, *Musa*, *Nicotiana tabacum*, *Phaseolus vulgaris*, *Pisum sativum*, *Prunus armeniaca*, *Prunus domestica*, *Prunus persica*, *Purshia tridentata*, *Rosa chinensis*, *Rosa large-flowered bush hybrids*, *Rosa*, *Selenicereus undatus*, *Sinningia speciosa*, *Solanum lycopersicum*, *Solanum muricatum*, *Streptocarpus ionanthus*, *Vaccinium*, *Vitis vinifera*, *fruit plants*, *herbaceous ornamental plants*, *vegetable plants*, *x Citrofortunella floridana*

GEOGRAPHICAL DISTRIBUTION

F. occidentalis is indigenous to North America (Canada, Mexico, continental USA). It began to spread internationally about 1980 and has now been reported from countries in all continents of the world.



EPPO Region: Albania, Algeria, Armenia, Austria, Azerbaijan, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France (mainland), Germany, Greece (mainland, Kriti), Guernsey, Hungary, Ireland, Israel, Italy (mainland, Sardegna, Sicilia), Jordan, Latvia, Lithuania, Malta, Moldova, Republic of, Montenegro, Morocco, Netherlands, North Macedonia, Norway, Poland, Portugal (mainland, Azores, Madeira), Romania, Russian Federation (Central Russia, Eastern Siberia, Far East, Southern Russia, Western Siberia), Serbia, Slovakia, Slovenia, Spain (mainland, Islas Baleares, Islas Canárias), Sweden, Switzerland, Tunisia, Türkiye, Ukraine, United Kingdom (Channel Islands, England, Scotland)
Africa: Algeria, Burkina Faso, Egypt, Eswatini, Kenya, Morocco, Reunion, South Africa, Tunisia, Uganda, Zimbabwe
Asia: China (Anhui, Beijing, Chongqing, Fujian, Gansu, Guangdong, Guangxi, Guizhou, Hainan, Hebei, Heilongjiang, Henan, Hubei, Hunan, Jiangsu, Jilin, Liaoning, Neimenggu, Ningxia, Shaanxi, Shandong, Sichuan, Tianjin, Xinjiang, Xizhang, Yunnan, Zhejiang), India (Karnataka, Tamil Nadu), Indonesia (Java), Iran, Islamic Republic of, Israel, Japan (Hokkaido, Honshu, Kyushu), Jordan, Korea, Republic of, Kuwait, Lebanon, Malaysia (West), Myanmar, Qatar, Sri Lanka, Vietnam
North America: Canada (British Columbia, Manitoba, Nova Scotia, Ontario, Québec, Saskatchewan), Mexico, United States of America (Alabama, Arizona, Arkansas, California, Colorado, Connecticut, Delaware, Florida, Georgia, Hawaii, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, Nevada, New Jersey, New Mexico, New York, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, South Carolina, South Dakota, Tennessee, Texas, Utah, Vermont, Virginia, Washington, West Virginia, Wyoming)
Central America and Caribbean: Costa Rica, Dominican Republic, Guadeloupe, Guatemala, Honduras, Martinique, Panama, Puerto Rico
South America: Argentina, Brazil (Alagoas, Bahia, Ceara, Goias, Minas Gerais, Parana, Pernambuco, Rio de Janeiro, Rio Grande do Sul, Santa Catarina, Sao Paulo), Chile, Colombia, Ecuador (Galapagos), Guyana, Peru, Uruguay, Venezuela
Oceania: Australia (New South Wales, Queensland, South Australia, Tasmania, Victoria, Western Australia), New Caledonia, New Zealand

BIOLOGY

F. occidentalis reproduces throughout the year in glasshouse environments in the USA, producing as many as 12-15 generations per year (Bryan & Smith, 1956; Lublinkhof & Foster, 1977). The total life-cycle from egg to egg at 15, 20, 25 and 30°C is 44.1, 22.4, 18.2 and 15 days, respectively. Each female lays between 20 and 40 eggs. Pre-oviposition time is 10.4 days at 15°C and 2-4 days at both 20 and 30°C; highest reproductive rate (95.5 hatched

eggs/female) is at 20°C.

The eggs are inserted in the parenchyma cells of leaves, flower parts and fruits, and hatch in about 4 days at 27°C. This period is lengthened to 13 days at 15°C. The eggs are susceptible to desiccation, and high mortality at this stage is not uncommon. Adult thrips have been observed entering closed chrysanthemum buds, presumably to lay eggs, a behaviour pattern which makes control very difficult.

There are four larval stages; the first two are active, feeding stages and the last two non-feeding, pre-pupal and pupal stages. The first-instar nymph emerges from the plant tissue head-first and feeding begins almost immediately. The first moult occurs within 1-3 days at 27°C (7 days at 15°C). Second-instar nymphs are very active and often seek enclosed sites for feeding. Development time for this stage varies from 3 days at 27°C to 12 days at 15°C.

The second-instar nymph becomes progressively more sluggish, moults, and transforms into the early pseudopupa. The duration of this stage is one day at 27°C and four days at 15°C. The choice of pupation site varies; although usually in the soil it may also be in a flower. The greater the protection given by the flower structure, the greater the likelihood that this will be the chosen pupation site. The late pseudopupa moves very little. In a 30-day life-cycle, more than 10 days may be spent in this stage in the soil. The adult emerges after usually 2-9 days, depending on the temperature.

The newly emerged adult female is relatively quiescent during the first 24 h, but becomes extremely active when mature. The female usually lives about 40 days under laboratory conditions but can survive as long as 90 days. The male lives half as long as the female. Oviposition normally begins 72 h after emergence and continues intermittently throughout almost all adult life. At 27°C, females lay a mean of 0.66 to 1.63 eggs per day. In a population, there are usually four times as many females as males. Males derive from unfertilized eggs, which can be produced by unmated females.

In California (USA), *F. occidentalis* survives the winter outdoors, chiefly in the adult stage, although a few fully grown nymphs are occasionally found during the colder months in flower and leaf buds. There is a preponderance of females in the winter and early spring since the males are shorter-lived and apparently less resistant to winter conditions.

In southern New Mexico (USA), a dry winter was found to be favourable for the successful overwintering of adult *F. occidentalis*. Rain in spring and summer allowing good growth of vegetation resulted in a heavy thrips population. However the species is said to be the commonest flower thrips outdoors in coastal British Columbia (Canada), so it is clearly able to survive a damp and cool climate. So far it has not been shown to overwinter outdoors in Europe.

In addition to feeding on plant tissues, nymphs and adult females of *F. occidentalis* are known to be omnivorous and will feed on the eggs of mites when these are abundant on plants.

F. occidentalis is a vector of tomato spotted wilt virus (TSWV) and of tobacco streak ilarvirus (TSV). Only the nymphs, and not the adults, can acquire the virus. The acquisition time is at least 30 min, and the insect becomes infective in 3-10 days (by which time it is usually adult). It then needs to feed for at least 15 min to transmit.

It is possible that the rapid spread of the pest since about 1980 may follow a change in some aspect of its biology. The older literature should, accordingly, be treated with caution.

DETECTION AND IDENTIFICATION

Symptoms

The major symptoms of F. occidentalis infestation include a discoloration of the upper leaf surface, and indentation where damage occurs. The pattern of damage is coarser than damage by Thrips tabaci. Silvering, deformity, growth malfunction and brown bumps may also be present on the foliage of ornamental plants. 'Halo spotting', another symptom of thrips damage, consists of small dark scars surrounded by whitish tissue. On some host plants, e.g. Capsicum, oviposition causes a reaction of the surrounding plant tissue.

Thrips feeding causes discoloration and scarring of open blooms and petals. It also results in deformation of buds if the feeding occurs before they start opening. Thrips damage can be distinguished from spider-mite damage by the appearance of liquid faecal deposits which cause dark-green speckling, whereas spider mites produce black granules.

Eggs laid in petal tissue causes a 'pimpling' effect in flowers such as orchids.

Morphology

Eggs

Opaque, reniform and about 200 µm long.

Nymph

There are two instars, the first translucent and the second golden-yellow.

Pupa

The early pseudopupa is characterized by the appearance of wing pads and shortened, erect antennae.

The late pseudopupa shows extreme reluctance to move; adult setal patterns start forming; wing sheaths longer; antennae turned backwards. Both pupal stages are white.

Adult

A tiny (generally less than 2 mm long), slender insect with narrow fringed wings. The adult male thrips is smaller than the female, has a narrow abdomen with a rounded end and is pale-yellow (almost white). The adult female thrips has a more rounded abdomen ending in a point and the coloration can vary from yellow to brown. In America, three colour forms of F. occidentalis have been distinguished, pale, intermediate and dark, whose relative abundance differs according to the season. In spring, following the wet season, the dark form predominates; during the rest of the year the pale form is dominant. The intermediate form maintains a fairly constant proportion throughout the year. An explanation is that the dark form is better able to survive and is more active than the pale form during cold and wet periods. Only females express coloration phenotypically.

The genus Frankliniella can be separated from other genera of thrips by means of the following characters: the principal vein of the anterior wing has regularly spaced bristles from the base to the apex (14-19 in F. occidentalis); the anterior edge of the prothorax carries a bristle pair clearly longer than the others; the antenna has eight segments (seven in Thrips). The separation into species is a task for experts (Moulton, 1948).

PATHWAYS FOR MOVEMENT

Thrips are easily carried into glasshouses by wind, making reinfestation a constant problem. They are also easily carried on clothes and hair, and on equipment and containers which have not been properly cleaned.

Female thrips can be aggressive to one another. Perhaps because of this aggression, the generally secretive adults can be seen to run, jump and fly within a crop and this can result in even small populations becoming widespread within a glasshouse.

Internationally, *F. occidentalis* is liable to be carried on any plants for planting or on cut flowers.

PEST SIGNIFICANCE

Economic impact

F. occidentalis attacks the flowers and foliage of a great number of crops. Evidence of F. occidentalis damage can

vary depending on the crop attacked and the growth stage of the plant at the time of attack. As well as feeding on plant fluids with their sucking mouthparts, F. occidentalis also eats the pollen and nectar of many plants, and the spreading of pollen during this feeding results in pollination and premature senescence - which can be a serious problem with certain ornamental crops such as Saintpaulia.

F. occidentalis is a very important pest of ornamental flower crops as it takes only a few individuals to scarthe marketable portion of the crop, the flower. Because of this, the thrips is a 'direct' pest of such crops, unlike other (indirect) pests such as mites or leafminers which generally attack the foliage, permitting control treatments to be applied before damage reduces the aesthetic quality of the crop.

F. occidentalis also attacks vegetables under glass and the decline in cucumber production in British Columbia (Canada) is attributed mainly to the spread of this pest. For example, in 1985, F. occidentalis was estimated to have caused a 20% yield loss in the glasshouse cucumber crop.

In California (USA), F. occidentalis also causes damage outdoors, on lucerne (by larval feeding on flowers and young pods) and on fruit trees (by scarring and silvering the surface of the fruit, especially in Prunus). Nursery stock of fruit trees and roses is also damaged, the terminal buds being killed or weakened. A range of other crops in North America is damaged by this pest to a greater or lesser extent (see Hosts).

F. occidentalis has been associated with outbreaks of tomato spotted wilt virus (TSWV) on tomatoes in Ontario (Canada). The symptoms of this disease include stunting, distortion and mosaic mottling of leaves, and clearing of leaf veins and fruit. TSWV causes severe loss (50-90%) of lettuces in Hawaii (USA), particularly in the major vegetable-growing area of Kula. Twenty-five weed species found in Kula serve as reservoirs for F. occidentalis,17 of which may harbour TSWV. In lettuce fields there is a high correlation between thrips populations and TSWV incidence. In Louisiana (USA) the incidence of TSWV in tomato, pepper and tobacco crops has increased dramatically since about 1978. The infection can reach 60% in commercial fields and 100% in gardens. It is thought that the expanded geographical range of F. occidentalis into Louisiana is responsible for the increase of TSWV. However, it has also been suggested that the role of F. occidentalis as the vector of the virus in California has been over-emphasized, and that Thrips tabaci is probably more important.

In the EPPO region, direct damage by F. occidentalis occurs entirely on glasshouse or protected ornamental and vegetable crops. On flower crops some silvering and distortion of leaves due to feeding may be noticeable. When present, the flowers are the preferred site for feeding. Petals may be scarred or discoloured. The thrips feeds also on the pollen and this may be dislodged to fall onto surrounding foliage. If this then becomes infected by sooty moulds, the general appearance of the plant is damaged. Knowledge of the damage caused by this thrips to ornamental foliage plants is limited. However, as the value of these plants is greatly reduced, even by slight damage, any infestation is liable to have an economic effect. F. occidentalis may affect most fruiting vegetables with the exception of tomatoes. Problems are most severe on cucumbers where the blossoms can be reduced or so extensively damaged that no fruit is produced. The cucumber fruits often show severe distortion.

For a general bibliography of F. occidentalis, see Mantel (1989).

Control

Chemical control is particularly difficult because of the secretive habit of the species and because of the appearance of resistance. Introduction of the pest into glasshouses in Europe has severely interfered with the routine practice of integrated pest control. Control treatments must be supplemented by hygiene measures within glasshouses. Biological agents such as Amblyseius barkeri and Neoseiulus cucumeris have also been used.

It is also quite possible that the thrips could damage outdoor crops in Mediterranean countries, and it has already been reported on outdoor crops in Spain. Moreover, the present spread of TSWV on ornamental and vegetable crops in Europe (EPPO/CABI, 1996) is most probably related to the wider distribution of F. occidentalis.

Phytosanitary risk

F. occidentalis is an EPPO A2 quarantine pest (OEPP/EPPO, 1989). It is also of quarantine significance for CPPC and OIRSA. Its introduction and rapid spread to many EPPO countries, and the problems presented by its presence in glasshouses, illustrate clearly the serious nature of this pest and the potential threat to the glasshouse industry in

countries still free from the pest.

PHYTOSANITARY MEASURES

Treatments against *F. occidentalis* on plants in transit are unlikely to be entirely successful because of the ability of the pest to secrete itself in small crevices and tightly closed plant parts, because the eggs are protected by the epidermis of the host, and because of the subterranean habit of certain stages. In addition, resistance has developed to certain pesticides. Accordingly, the only safe measure is to ensure that the place of production is free from the pest by appropriate inspection (OEPP/EPPO, 1990).

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