EPPO Datasheet: *Tetranychus evansi*

Last updated: 2021-03-08

IDENTITY

Preferred name: *Tetranychus evansi*
Authority: Baker & Pritchard
Taxonomic position: Animalia: Arthropoda: Chelicerata: Arachnida: Acarida: Tetranychidae
Other scientific names: *Tetranychus takafujii* Ehara & Ohashi
Common names: red spider mite, red tomato spider mite
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EPPO Categorization: A2 list
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EPPO Code: TETREV

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Notes on taxonomy and nomenclature

The earliest record of a red spider mite damaging tomatoes (*Solanum lycopersicum*) was reported in 1952 by Silva (1954) in Brazil under the name of *Tetranychus marianae*. Although *Tetranychus evansi* was first described in 1960, *T. evansi* was regularly misidentified as *T. marianae* over a number of years. These included identifications by Moutia (1958) in Mauritius on tomato, aubergine (*Solanum melongena*), potato (*Solanum tuberosum*) and peanut (*Arachis hypogea*), Wene (1956) and Schuster (1959) in their reports from USA (Texas) on tomato, and Rossi de Simons (1961) in Argentina on nightshade (*Solanum americanum*). In 1960, Baker & Pritchard's *T. evansi* description was made from Moutia specimens collected in Mauritius. However, Wolfenbarger & Getzin (1964), Harper (1966) and Oatman *et al.* (1967) for California, Denmark (1970) for Florida, Rossi de Simons (1971) for Argentina and Paschoal and Reis (1968) for Brazil used the wrong name of *T. marianae*. Denmark (1973) subsequently corrected the identification made for Florida on tomatoes and aubergines. Qureshi *et al.* (1969) used the name *T. evansi* for their biological study. Finally, Moraes *et al.* (1987) re-examined all previous specimens. They established a clear distinction between *T. evansi* and *T. marianae* and corrected prior misidentifications.

Conversely, Gutierrez (1974, 1983) misidentified *T. marianae* collected in Seychelles under the name of *T. evansi*. This error is now corrected in the GBIF database where his observations are recorded (Migeon, 2015 and 2021).

Tetranychus takafujii Ehara & Ohashi, 2002 is a junior synonym for *T. evansi* (Gotoh *et al.*, 2009). It was reported in Japan in Tokyo Bay, Kyoto district and Osaka Bay from *Solanum caroliniense*, *Solanum nigrum* and aubergine (*Solanum melongena*).

HOSTS

Solanaceae are the main hosts to *Tetranychus evansi*. Four species of economic importance are particularly susceptible to damage: aubergine (*Solanum melongena*), tomato (*Solanum lycopersicum*), potato (*Solanum tuberosum*) and tobacco (*Nicotiana tabacum*). Chillies and peppers (*Capsicum annuum*) are less damaged. A wide range of Solanaceae found as weeds are also host plants. Among them, the cosmopolitan weeds *Solanum nigrum* and *Solanum americanum* are the main host species. *Tetranychus evansi* has been reported to damage crops belonging to the Fabaceae, such as bean (*Phaseolus vulgaris*) in Africa, and peanuts (*Arachis hypogea* and *A. prostrata*) in Mauritius and Brazil. Thirty-seven families of plants are hosts for this species (see Migeon & Dorkeld, 2021 for a complete list). The other main host plant families are Amaranthaceae (*Amaranthus* and *Chenopodium*) and Asteraceae. In Spain (Ferragut & Escudero, 1999), very high densities of spider mites have been recorded on *Sonchus* spp. and *Erigeron* (syn. *Conyza*) spp. (Asteraceae), *Convolvulus arvensis* (Convolvulaceae), *Parietaria officinalis* (Urticaceae).

Host list: *Abelmoschus esculentus*, *Acanthospermum hispidum*, *Alkekengi officinarum*, *Amaranthus albus*, *Amaranthus blitoides*, *Amaranthus cruentus*, *Amaranthus hybridus*, *Amaranthus retroflexus*, *Anacardium occidentale*

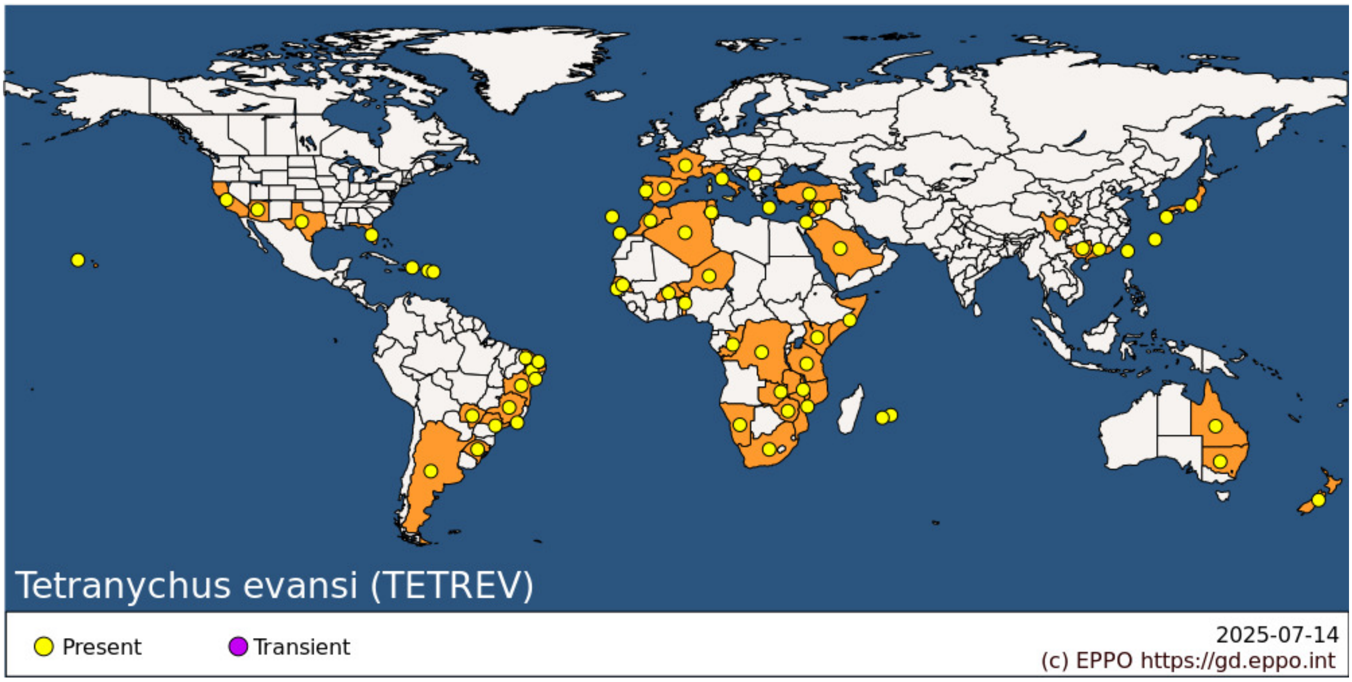
, *Andryala integrifolia*, *Arachis hypogaea*, *Arachis prostrata*, *Aristolochia sp.*, *Artemisia douglasiana*, *Asparagus sp.*, *Asystasia gangetica*, *Beta vulgaris*, *Bixa orellana*, *Brugmansia suaveolens*, *Calendula sp.*, *Capsella bursa-pastoris*, *Capsicum annuum*, *Carica papaya*, *Carlina corymbosa*, *Cestrum parqui*, *Chenopodiastrum murale*, *Chenopodium album*, *Chenopodium sp.*, *Chondrilla juncea*, *Cirsium arvense*, *Citrullus lanatus*, *Convolvulus arvensis*, *Cucumis sativus*, *Cynodon dactylon*, *Cyperus esculentus*, *Cyperus rotundus*, *Datura ferox*, *Datura innoxia*, *Datura stramonium*, *Dieffenbachia seguine*, *Dioscorea alata*, *Diplotaxis catholica*, *Diplotaxis erucoides*, *Dittrichia viscosa*, *Echium plantagineum*, *Erigeron bonariensis*, *Erigeron canadensis*, *Euphorbia sp.*, *Fragaria x ananassa*, *Fumaria officinalis*, *Galium aparine*, *Gossypium hirsutum*, *Gymnanthemum amygdalinum*, *Helminthotheca echioides*, *Hordeum murinum*, *Humulus scandens*, *Ipomoea batatas*, *Jacobaea vulgaris*, *Lantana camara*, *Lycopersicon sp.*, *Malva sylvestris*, *Malva trimestris*, *Nicandra physalodes*, *Nicotiana glauca*, *Nicotiana sp.*, *Nicotiana tabacum*, *Ocimum basilicum*, *Origanum majorana*, *Origanum vulgare*, *Parietaria officinalis*, *Passiflora foetida*, *Pelargonium sp.*, *Phacelia sp.*, *Phaseolus coccineus*, *Phaseolus vulgaris*, *Phoenix dactylifera*, *Physalis angulata*, *Physalis peruviana*, *Physalis pubescens*, *Physalis sp.*, *Portulaca oleracea*, *Psidium guajava*, *Pueraria sp.*, *Raphanus raphanistrum*, *Rapistrum rugosum*, *Ricinus communis*, *Rosa sp.*, *Rumex crispus*, *Salpichroa origanifolia*, *Salvia officinalis*, *Senecio vulgaris*, *Setaria pumila*, *Sida acuta*, *Solanum aethiopicum*, *Solanum americanum*, *Solanum anguivi*, *Solanum aviculare*, *Solanum capsicoides*, *Solanum carolinense*, *Solanum chacoense*, *Solanum chenopodioides*, *Solanum elaeagnifolium*, *Solanum erianthum*, *Solanum grandiflorum*, *Solanum incanum*, *Solanum lycopersicum*, *Solanum macrocarpon*, *Solanum mauritianum*, *Solanum melongena*, *Solanum nigrescens*, *Solanum nigrum*, *Solanum palinacanthum*, *Solanum paniculatum*, *Solanum quitoense*, *Solanum sp.*, *Solanum stramoniifolium*, *Solanum tuberosum*, *Solanum variabile*, *Sonchus oleraceus*, *Sonchus sp.*, *Taraxacum officinale*, *Trifolium dubium*, *Triumfetta semitriloba*, *Urtica dioica*, *Veronica sp.*, *Withania somnifera*, *Xanthium strumarium*

GEOGRAPHICAL DISTRIBUTION

This species originates from South America (Boubou *et al.*, 2011, 2012) and has been introduced to other parts of the world. Because the mite can easily be confused with other *Tetranychus* species, the distribution patterns of this pest worldwide have long been uncertain. However, due to the interest in *T. evansi* since the 2000s much more detailed information has been collected on its distribution.

History of invasion and world spread

In South America at least two different clades are known. Each clade has been introduced outside its natural area. The first one originating from Southern Brazil and Argentina has been introduced once in the Mascarenes Islands (first Mauritius), and from there to Africa and finally to the Western Mediterranean Basin. Another introduction event occurred in the Western Mediterranean Basin. The Mediterranean cluster is the source of all the following introductions that have been genetically characterized (East Mediterranean, Japan, Taiwan, China). This first clade seems to be more invasive (Meynard *et al.*, 2013) thanks to its higher cold resistance (Migeon *et al.*, 2015) and higher fitness coupled to differences in digestive enzymes (Santamaria *et al.*, 2018). The second clade originating from North-East Brazil is only present in Portugal, the North-East of Spain (Catalonia), and in France (close to the border with Catalonia) (Boubou *et al.*, 2011).



EPPO Region: Algeria, France (mainland), Greece (Kriti), Israel, Italy (mainland), Morocco, Portugal (mainland, Madeira), Serbia, Spain (mainland, Islas Canárias), Tunisia, Türkiye
Africa: Algeria, Benin, Burkina Faso, Congo, Congo, The Democratic Republic of the, Gambia, Kenya, Malawi, Mauritius, Morocco, Mozambique, Namibia, Niger, Reunion, Senegal, Somalia, South Africa, Tanzania, United Republic of, Tunisia, Zambia, Zimbabwe
Asia: China (Guangdong, Guangxi, Sichuan), Israel, Japan (Honshu, Kyushu, Ryukyu Archipelago), Saudi Arabia, Syrian Arab Republic, Taiwan
North America: United States of America (Arizona, California, Florida, Hawaii, Texas)
Central America and Caribbean: Dominican Republic, Puerto Rico, Virgin Islands (US)
South America: Argentina, Brazil (Bahia, Ceara, Mato Grosso do Sul, Minas Gerais, Pernambuco, Rio de Janeiro, Rio Grande do Norte, Rio Grande do Sul, Sao Paulo, Sergipe)
Oceania: Australia (New South Wales, Queensland), New Zealand

BIOLOGY

Reproduction and development

Tetranychid mites reproduce by arrhenotokous parthenogenesis. Unfertilized eggs develop into haploid males while diploid females are produced biparentally from fertilized eggs. The sex-ratio is about 70% females.

T. evansi reproduction is continuous throughout the year. No diapause has been observed for this species even in the coldest parts of its distribution area or for *T. takafujii* in Tokyo Bay (Ohashi *et al.*, 2003). However, during winter, the mites lay very few eggs that develop poorly (Migeon *et al.*, 2015). Observations made in France near Perpignan have revealed that mites overwinter at the plant collar on black nightshade (Migeon, personal observation). This could limit the distribution to warm and mild areas with moderately cold winters (Migeon *et al.*, 2009).

Navajas *et al.* (2013) have summarized the developmental rates from previous works. The theoretical minimal growing temperature is 12.1 °C, the optimal temperature is 37.9 °C and the maximal 45.1 °C. The duration of development from egg to adult ranges from 46 days at 15°C to 8-13 days at 25°C and 6 days at 35°C. The number of eggs laid by females varies from 80 with extreme low and high temperatures to a range of 120-250, as reported by different authors, for optimal temperatures. This mite has one of the highest rates of population increase among *Tetranychus* species which leads to heavily infested plants at the end of a favourable growing season. This phenomenon causes spectacular outbreaks and high mite populations can kill host plants. Dispersal behaviour is associated with outbreaks, in which mites form large aggregates at the top of the infested plants and are blown with the wind.

Aggregation and behaviour

T. evansi differs from other *Tetranychus* pests by its high level of aggregative behaviour (Azandémè-Hounmalon *et al.*, 2014), which, coupled with its high rate of population increase, leads to spectacular pest densities and webbing. This is the result of its ability to suppress plant defences (Sarmento *et al.*, 2011, Alba *et al.*, 2015, Schimmel *et al.*, 2017, Knegt *et al.*, 2020) locally favouring mites' aggregation and better performances on previously attacked plants instead of emigration as observed for example with the two spotted spider mite (*Tetranychus urticae*). The aggregations of mites close to the fruits, especially on black nightshade (*Solanum nigrum*) could constitute a passive dispersion pathway via bird plumage in relation to birds berry consumption (Williams & Karl, 1996, Palevsky pers. comm. 2007).

DETECTION AND IDENTIFICATION

Symptoms

Mites live on both sides of the leaves with a slight preference for the underside and for the vicinity of the veins. Feeding causes the leaves to become chlorotic. White to brown (depending on the plant species) spots caused by the mites' salivary contents appear on both sides and lead to the destruction of parenchyma cells. At high levels of infestation the leaves dry out and die. Silk webs are also produced. At high infestation levels the dense webs can "mummify" the plant. In very heavy infestations, which are frequent (contrary to other *Tetranychus* pests), feeding and webbing cause the death of the plant.

T. evansi also lives on and probably reproduces on potato tubers. Flechtmann (1968) reports high levels of infestation, with sprouts covered with a considerable amount of webbing.

Morphology

Descriptions of the mites are given by Silva (1954), Baker & Pritchard (1960), Jeppson *et al.* (1975), Moraes *et al.* (1987) and Ehara & Ohashi (2002).

Eggs

Almost spherical (average size 120 µm). Newly laid, they are bright and hyaline but later become rust red prior to hatching.

Larval and nymphal stages

In Tetranychidae, three different mobile immature stages, followed by immobile stages are observed. Pre-adult stages are greenish yellow.

The first stage, larva (size: 150 µm), bears only 3 pairs of shorts legs. It is followed by the protochrysalis before moulting. The protonymph bears 4 pairs of legs and is followed by the immobile deutochrysalis. The deutonymph (size: 310 µm) looks like a small adult with shorter legs.

Adult

Both sexes vary in colour, depending on age and host plants. Older individuals are darker. The basis of the coloration is orange but it can vary from light orange to dark red or even brown. Unlike *T. urticae,* the two black spots are lacking.

Females are a broad oval shape with an average size of 450 x 335 µm. In comparison with many other species of the genus *Tetranychus*, the legs are longer. The body setae are not a criterion to distinguish from other species. Nevertheless, the setae borne by the first pair of legs can be useful: the female of *T. evansi* have the proximal (to the body) duplex setae (a very long and a short setae paired) in line with the four other setae.

Males are much smaller than females and elongate, triangular in shape with an average size of 350 x 210 µm. The lateral shape of the male aedeagus is one of the most useful criteria for the specific diagnostics but only if it is associated with the examination of the female tarsus I.

The EPPO Diagnostic Protocol for *T. evansi* provides recommendations on how to detect and identify the pest (EPPO Standard PM 7/116).

Detection and inspection methods

The mites can be present on plant material, especially plants for planting (Solanaceae) but also on potato tubers. Mites may be found on fruits peduncles and sepals of plants such as aubergines if these provide enough space for the mites to shelter. At low densities, spider mites are extremely difficult to detect. Inconspicuous (less than half a millimetre) they can be invisible to the naked eye. Attention should focus on small whitish, brownish or yellow spots (symptoms which could also be caused by viruses or superficial wounds). An examination of the both sides of the leaves under a stereo-microscope will confirm (or not) the presence of spider mites, generally associated with white exuviae and webbing. On hairy plants like aubergines exuviae can be seen on the hairs. However, *T. evansi* with its orange colouration, its highly aggregative behaviour and its faculty to live on both sides of the leaves is easier to detect than other tetranychid mites.

PATHWAYS FOR MOVEMENT

Local movement is mainly linked to wind currents. Workers (via clothing and tools) and birds (via their feathers when they feed on black nightshade berries) can spread the mites over short distances. In international trade, *T. evansi* may be carried on Solanaceous plants for planting (except seeds) and this is the hypothesis used to explain the introduction of the pest e.g. in Africa. *Tetranychus evansi* can also be carried on Solanaceous weeds (black nightshade and other *Solanum* spp. weeds) developing in plant (especially trees and shrubs) containers. The mites are less likely to infest fruits and potato tubers: these only present a risk where peduncles are present (aubergines, vine tomatoes, and to a lesser degree, chillies and peppers). Fresh beans are not a very frequent host plant, but the high levels of trade of this commodity from countries and regions with high *T. evansi* populations could constitute a pathway. However, transfer from host fruits, or potato tubers to host plants is unlikely. *Tetranychus evansi* could be transported as a contaminant of non-solanaceous plants for planting (except seeds) cultivated in the vicinity of infested host plants (EPPO, 2008).

The only report of interception of *T. evansi* during phytosanitary inspections at import was in consignments of aubergine fruits in the United-Kingdom (MacLeod, 2005).

PEST SIGNIFICANCE

Economic impact

T. evansi is regarded as an important pest of tomato and other solanaceous crops. In Eastern and Southern Africa, it has been considered the most important dry season pest of tomatoes (Knapp, 2002) since it was first recorded in 1979 and yield losses are noted. In Western Africa, it damages tomatoes and aubergines (Duverney & Ngueye-Ndiaye, 2005) and in Benin since its first record in 2008, it represents an important pest for African aubergines (*Solanum macrocarpon*) with production losses estimated at 65%, as well as of tomatoes (56% losses), amaranths (*Amaranthus cruentus*) (25% losses) and bitter leaf (*Vernonia amygdalina*) (Azandémé-Hounmalon *et al.*, 2015).
T. evansi is one of four species of red spider mites causing damage in vegetable crops in Eastern Spain (Escudero and Ferragut, 2005), although there is no specific data on economic impact caused by *T. evansi* alone (EPPO, 2008). In Spain, damage has only been recorded in outdoor crops such as aubergine, potato and tomato and the same observations have been made in Israel on aubergine and potato. The most severe damage in Israel occurs on aubergine. Few outbreaks are recorded under protected conditions, even in areas where the pest is present outdoors on weeds. In some situations, the use of acaricides may be the reason why *T. evansi* does not establish in protected conditions. In EPPO countries where *T. evansi* is present it can kill *Solanum nigrum* but such damage has not been

noted on other host plants. An outbreak in an organic farming production unit was detected in Southern France on tomato in protected cultivation in October 2007. This illustrates the potential of the pest to cause damage in protected organic farming cultivation (EPPO, 2008).

Control

Acaricides are commonly used against *T. evansi* and other spider mites on Solanaceous crops. Mite populations have developed resistance, in particular in Zimbabwe during the 1980s but current use of non organo-phosphorous acaricides is effective at controlling populations although it does not allow integrated crop protection or organic production.

The widely used phytoseiid mites, *Neoseiulus californicus* and *Phytoseiulus persimilis* show a poor ability to suppress *T. evansi* populations on commercial crops (Escudero & Ferragut, 2005). Research has been conducted to identify natural enemies associated with *T. evansi* in Southern America (Rosa *et al.*, 2005; Furtado *et al.*, 2006; Fiaboe *et al.*, 2007). A potential natural enemy: *Phytoseiulus longipes* has been identified in Brazil and Argentina: (Ferrero *et al.*, 2007). *Stethorus gilvifrons* (Coleopotera: Coccinellidae) and *Feltiella acarisuga* (Diptera: Cecidomyiidae) have been identified in association with *T. evansi* colonies on tomato and black nightshade in Syria (Dayoub *et al.*, 2020). *Stethorus pusillus* has also been observed in France (Migeon, personal observation).

The use of the fungus *Metarhizium anisopliae* has shown to be effective in laboratory under certain conditions (Wekesa *et al.*, 2005, Azandémè-Hounmalon *et al.*, 2018).

Phytosanitary risk

T. evansi is a threat for tomato, aubergine and potato grown outdoors in the Mediterranean part of the region (Migeon *et al.*, 2009) and for tomato and aubergine grown in protected cultivation in the whole EPPO region (EPPO, 2008). The main risk of introduction is with plants for planting of Solanaceae and Solanaceae weeds in plant containers. For at least twenty years now, the mite has been established along the North rim of the Mediterranean and some high infestations were reported during the first years of its discovery. However, more recently, the spread of the pest seems to have slowed and no further outbreaks are recorded in this area, although the mite can still be found in the wild, in fields or in protected cultivation.

PHYTOSANITARY MEASURES

EPPO (2008) recommends that plants for planting of *Solanaceae* (except seeds) should come from pest free areas or pest free places of production, or be treated with an acaricide targeting adults and eggs and inspected. It may be noted that the importation of plants for planting of *Solanaceae* from third countries is prohibited in many EPPO countries, but is allowed e.g. between EU countries.

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