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Report of a Pest Risk Analysis for *Tetranychus evansi*

This summary presents the main features of a pest risk analysis which has been conducted on the pest, according to EPPO Decision support scheme for quarantine pests.

Pest:	*Tetranychus evansi*
PRA area:	EPPO region
Assessors:	**Mr Peter Baufeld** (BBA, DE) Federal Biological Research Center for Agriculture and Forestry **Mr Francisco Ferragut (**Agroforestry ecosystems division University of Valencia, ES), **Mr Alan MacLeod** (Central Science Laboratory, GB), **Mr Alain Migeon** (INRA French National Research Institute, FR) **Mr Eric Palevski** (Dept of Entomology Newe-Ya'ar Research Center, Agricultural Research Organization, Ministry of Agriculture, IL), **Ms Irène Vaninen** (MTT, Agrifood Research Finland, Plant Production Research, FI),
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STAGE 1: INITIATION

Reason for doing PRA:	The EPPO Secretariat was informed in early 2004 by the French NPPO that the spider mite, *Tetranychus evansi* was spreading within Mediterranean countries. As *T. evansi* is a pest of tomatoes and other solanaceous crops, *T. evansi* was added to the EPPO Alert List in May 2004 (EPPO, 2004). The Panel on Phytosanitary Measures recommended that a PRA should be performed.
Taxonomic position of pest:	Acari, Tetranychidae

STAGE 2: PEST RISK ASSESSMENT

Probability of introduction

Entry

Geographical distribution:	*T. evansi* is suspected to originate from South America. It has been unintentionally introduced to other parts of the world. Because the pest can easily be confused with other *Tetranychus* species, there is uncertainty on the pest distribution, e.g. it could be present on crops but considered to be another *Tetranychus* species, or present but disregarded on non-crop plants. Geographic distribution of *T. evansi* **EPPO region**: France (Pyrénées-Orientales, Alpes Maritimes, Var), Greece (EPPO, 2007), Israel (EPPO, 2006a), Italy (Liguria, EPPO 2006b), Jordan (Palevsky, pers. comm. 2007), Portugal (from Algarve to Lisbon including Madeira), Spain (Canary Islands, Baleares Islands, along the Mediterranean coast, Atlantic coast of Andalusia).

Asia: Israel (EPPO, 2006), Jordan (Palevsky, pers. comm. 2007), Taiwan (including Kinmen and Lienchang Islands). If *T. takafujii* is shown to be a synonym of *T. evansi*, then the pest would also be known to occur in Japan.

Africa: Democratic Republic of Congo, Congo, Gambia, Kenya, Malawi, Mauritius (including Rodrigues island), Morocco, Mozambique, Namibia, Niger (pers. comm. Migeon, 2007), Reunion Island, Senegal, Seychelles, Somalia, South Africa, Tunisia, Zambia, Zimbabwe. Detections of *T. evansi* on consignments of plant products from Gambia, suggest that *T. evansi* may also be present in Gambia (MacLeod, pers. comm. 2007).

North America: USA (Arizona, California, Florida, Texas, Hawaii).

Central America and Caribbean: Puerto Rico, Virgin Islands

South America: Brazil, Argentina

Oceania: Hawaii (USA).

<u>Major host plants or habitats:</u>

T. evansi is polyphagous. It has been reported on 31 plant families (Spider Mites Web Database, Migeon & Dorkeld, 2007). Major hosts are within the *Solanaceae.*

Cultivated hosts

The primary cultivated solanaceous hosts are tomato (*Lycopersicon esculentum*) (Silva, 1954; Migeon, 2007), aubergine (*Solanum melongena*) (Moraes *et al.*, 1987a; Leite *et al.*, 2003), potato (*S. tuberosum*) (Escudero & Ferragut, 2005), tobacco (*Nicotiana tabacum*) (Blair, 1989) and to a lesser degree peppers and chillies (*Capsicum annuum*) (Silva, 1954). Bean (*Phaseolus vulgaris*) is a cultivated non-solanaceous host (Gutierrez & Etienne, 1986).

The EWG regarded the following crops as secondary, or minor, hosts since there are very few records in the literature of *T. evansi* occurring on them, *Abelmoschus esculentus* (Tuttle *et al.* 1977), beetroot (*Beta vulgaris*) (Aucejo *et al.*, 2003), *Phacelia* sp. (Qureshi *et al.* 1969), cotton (*Gossypium hirsutum*) (Wene, 1956), castor bean (*Ricinus communis*) (Ho *et al.* 2004), peanuts (*Arachis hypogea* and *A. prostrata*) (Moutia 1958, Chiavegato & Reis 1969, Feres & Hirose 1986), sweet potato (*Ipomea batatas*) (Moutia, 1958), watermelon (*Citrullus lanatus* (Ferragut, pers. comm. 2007), and *Rosa* spp. (Qureshi *et al.* 1969).

Weeds

The preferred host for *T. evansi* is the widespread weed *Solanum nigrum* (Migeon, 2007). Other weed hosts include *Amaranthus blitoides*, *Chenopodium* spp. (El Jaouani, 1988), *Convolvulus arvensis*, *Conyza* spp., *Diplotaxis erucoides*, *Hordeum murinum, Lavatera trimestris*, *Sonchus* spp. (Ferragut & Escudero, 1999; Aucejo, Foo, Gimeno, *et al.*, 2003). INRA Spider Mites Web database (Migeon & Dorkeld, 2007) provides a more extensive lists of hosts / plants on which *T. evansi* has been recorded.

Pest: *Tetranychus evansi*

Which pathway(s) is the pest likely to be introduced on:

Within the literature concerning *T. evansi*, there is nothing explaining how it has spread internationally. Detections in consignments show that it can survive shipment on produce but this does not show that it would be able to transfer to a suitable host or establish in the country of destination. In the absence of evidence for T. evansi, it is appropriate to consider evidence from related species. Yaninek (1988) examined dispersal of Mononychellus tanajoa (cassava green mite). It was concluded that this mite disperses within plants by walking, and within and between fields by drifting aerially. Movement of mite-infested plant material was proposed to explain the rapid intra-continental spread of M. tanajoa in Africa.

The EWG considered the following possible pathways,

1. *T. evansi* on plants for planting of *Solanaceae* except seeds (e.g. tomato plants, aubergine plants, potato tubers, micro plants or mini-tubers, and ornamentals including potted plants);
Although it is considered as the most likely pathway the likelihood was considered as low to medium as most rating in the entry section of the decision support scheme indicate a low to medium likelihood. The Panel on Phytosanitary Measures considered that the risk was rather medium as it is a pathway of plants for planting.

2. *T. evansi* on host plant produce e.g. tomato fruit, including tomatoes "on the vine", aubergine fruit, potato tubers for consumption and beans; This pathway was considered to have a very low likelihood.

3. *T. evansi* as a hitchhiker on non-solanaceous plants for planting (except seeds).
This pathway was considered because if minor host, or even non-host, plants for planting are cultivated in an area where *T. evansi* occurs, the plants for planting could be infested (Palevsky, pers. comm. 2007). It was also noted that another species *Tetranychus urticae* can survive at least two days at 24^{o}C without food and resume feeding and reproduction afterwards; at lower temperatures, the survival times are assumed to be even longer (Krainacker & Carey, 1990). Thus even mites landing on a non-suitable host plant could be carried to the destination of the plant material in such condition that it allows subsequent reproduction provided they end up on a suitable host plant after arrival.
After the evaluation performed in the entry section, the EWG considered that the likelihood was very low to low
In addition, the EWG thought that the following were possible pathways, but for the reasons given below, they were not considered further:

4. On *Rosa* as cut flowers. The EWG contacted M. Knapp, who has many years of experience working with *T. evansi* in Kenya. Mr Knapp was asked whether *Rosa* was likely to provide a pathway. He thought it very unlikely. This opinion is independently supported by the lack of detections reported in consignments of *Rosa* despite an inspection regime in the EU. There has been one notification of non

compliance on a consignment of cut flowers of Rosa from Kenya which was reported to EPPO by Cyprus but it only refers to "acari" no information is available on the species. *T. urticae* is a common pest on roses.

5. Natural spread through aerial dispersal.
This is mainly dispersal from plot to plot. Cassava mites dispersed between plots by wind but movement throughout Africa is mainly with plant material. Wind dispersal alone does not seem sufficient enough to explain dispersal in the region. This was not considered further since no phytosanitary measures could be put in place to prevent such spread

Establishment

<u>Plants or habitats at risk in the PRA area:</u>

The preferred host (*S. nigrum*) and at least three major cultivated hosts (aubergines, tomatoes and potatoes) are widely distributed in EPPO member countries.

<u>Climatic similarity of present distribution with PRA area (or parts thereof):</u>

T. evansi is a warmth-loving pest. A study by Bonato (1999) showed that the optimal temperature for population growth is 34°C. The shortest developmental time (6.3 days) occurs at 36°C. At 25°C, the life cycle is completed in 13.5 days. After finding *T. evansi* on *Solanum nigrum* at two localities in the south of France near the Spanish border, Migeon (2005) compared the climatic conditions in parts of the USA where this organism occurs with the climate of France and concluded that it could only establish outdoors in France in a narrow band around the Mediterranean coast and on Corsica. Elsewhere in France, colder winters and lower summer temperatures would probably limit the outdoor distribution of the pest.

Moraes & McMurtry (1987) conducted experiments on *T. evansi* at five constant temperatures, on excised leaves of *Solanum douglasii*, to deduce the theoretical lower threshold temperature for development of each life stage and the thermal sum for complete development.

Based on this data, the EWG concluded that *T. evansi* would be able to develop outdoors during the summer in much of the EPPO area. However, it is unlikely that *T. evansi* would be able to overwinter successfully much outside the area around the Mediterranean (Migeon, 2005; 2007).

During the meeting a map of potential distribution outdoors was prepared and is presented in Appendix 1.

In conclusion, the outdoor Mediterranean climate is most favourable for the pest to establish. With irrigation the pest would probably also be able to establish in more arid areas in North Africa and the Middle East.

In protected conditions, in a heated glasshouse *T. evansi* could very easily survive, year round, with perhaps ten to 15 generations through the year. It could also survive year round in an unheated glasshouse, with perhaps 3 or 4 generations per year.

Note: *T. takafujii*, that is suspected to be a synonym of *T. evansi*, has been described in Japan, in the Osaka and Tokyo regions. Climatic conditions in these parts of Japan are cooler than in other countries where *T. evansi* presently occurs. If the synonymy is confirmed the area within the PRA area where climatic conditions are suitable for establishment would extend further North.

Characteristics (other than climatic) of the PRA area that would favour establishment: Current biological control agents are not efficient against *T. evansi.*

Which part of the PRA area is the endangered area: The endangered area is the whole area of EPPO countries.

POTENTIAL ECONOMIC CONSEQUENCES

How much economic impact does the pest have in its present distribution:

In African countries where *T. evansi* is established, it has been reported as a serious pest in particular of tomato. Of the thirteen known spider mite species on Reunion, *T. evansi* is one of the most destructive pests on crops (Gutierrez & Etienne, 1986). In Southern Africa *T. evansi* is considered as the most important dry season acarine pest of tomatoes (Fiaboe, 2007). Severe damage is also recorded on aubergine (Migeon, pers. comm. 2007). Infested tomato plants turn yellow, green then brown. Plants generally show a bleached yellow-orange or russeted appearance. Infested plants may be killed very rapidly (Jeppson *et al.*, 1975). In Zimbabwe, up to 90% yield losses have been recorded from field trials. However, it should be noted that with improved use of plant protection products, the damage on crops could be significantly reduced (Knapp *et al* 2003).

T. evansi is one of four species of red spider mites causing damage in vegetable crops in eastern Spain (Escudero & Ferragut, 2005), although there is no specific data on economic impact caused by *T. evansi* alone (Ferragut, pers. comm. 2007). In Spain, damage has only been recorded in outdoor crops such as aubergine, potato and tomato (Ferragut, pers. comm. 2007) the same situation occurring in Israel on aubergine and potato. The most severe damage in Israel occurs on aubergine (Palevsky pers. comm. 2007). 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 explanation as to why *T. evansi* does not establish in protected conditions. In infested EPPO countries *T. evansi* can kill *Solanum nigrum* but such damage has not been noted on other host plants.

At the time of the meeting no outbreak had been reported in organic farming but a recent outbreak causing serious damage has been detected in southern France on tomato in protected cultivation in October 2007 (Migeon, pers. comm. 2007). This illustrates the potential of the pest to cause damage in protected organic farming cultivation although it seems to be the first record for the region. One explanation to the low number of records of outbreaks in protected cultivation may be that cultivars grown in protected cultivation in Israel and Spain are different from those used in Africa outside. Differences in cultivar susceptibility but also of growing conditions in Africa and Europe could explain why the pest has showed to be more damaging in Africa than in Europe.

In the US the pest was detected in the 1950's. In Florida, *T. evansi* is the spider mite most often found attacking solanaceous crops like tomato, eggplant and potato (Gillet *et al.*, 2006). It is recorded in Brazil that the effectiveness *Euseius concordis* (Chant) a predator of *Aculops lycopersici* (tomato russet mite) was limited by the presence of *Tetranychus evansi*, the problem being with the webbing of *T. evansi* inhibiting its activity (Moraes & Lima, 1983).

Describe damage to potential hosts in PRA area:

Damage is similar to other spider mites. Feeding punctures led to whitening or yellowing of leaves, followed by desiccation, and eventually defoliation. In case of severe attacks, plants may die. Mites and their webbing can be seen on the underside of the leaf. (symptoms of severe infestation are shown in doc 07-13924 EPPO datasheet for *T. evansi*)

How much economic impact would the pest have in the PRA area:

If infested plants for planting are introduced in protected cultivation where no plant protection products are used, *T. evansi* has the potential to cause economic damage although we do not know about the susceptibility of cultivars used.

It should be noted that there are examples of mites which have been present without causing damage for more than a decade before reaching pest status, e.g. *Oligonychus afrasiaticus* was detected in Israel in 1980 in palm orchards on weeds. Commercial damage to palms was only reported in 1996. A similar situation could happen with *T. evansi* (Palevsky pers. comm. 2007).

CONCLUSIONS OF PEST RISK ASSESSMENT

Summarize the major factors that influence the acceptability of the risk from this pest:

Estimate the probability of entry:

Although *T. evansi* has already entered the EPPO region, the probability of entry is considered to be low and the likelihood of entry with the pathways identified is low.

P1: Plants for planting of Solanaceae. Entry = medium. At the moment the experience in EPPO countries with the pest is that the likelihood of infestation of a crop resulting from introduction of infested plant material is medium. No interceptions have been recorded.

P2: Fruits of *Solanaceae,* potato tubers for consumption and beans. Entry = very low. There have been very few interceptions. Transfer to hosts is unlikely.

P3: Hitchhiking on plants for planting (except seeds) other than *Solanaceae*. Entry = very low to low

There have been no interceptions. Transfer to hosts is unlikely.

Estimate the probability of establishment:

Probability of establishment = High

<u>Elements favouring establishment</u>

Host plants, including wild hosts, are widely available

Climatic conditions are suitable both outdoors and under protected

	conditions Biological control agents are not efficient against *T. evansi* <u>Elements inhibiting establishment (in protected crops)</u> Plant protection products are currently effective The EWG made the hypothesis that cultivars grown in protection could be resistant. Greatest risk of establishment is in the Mediterranean part of the EPPO region but also under protected cultivation.
Estimate the potential economic impact:	The most significant economic damage has been recorded in Africa where yield losses are noted. In EPPO countries where the pest is present it does not cause important economic damage, and outbreaks are mainly recorded outside. It is suspected that the glasshouse environment in EPPO countries, including control regimes and cultivars grown, differ from those in Africa. One plausible explanation for the lack of *T. evansi* infestation in protected conditions (screen houses and green houses) in the EPPO countries where it is present could be host plant resistance of the tomato cultivars grown in this area. Nevertheless an outbreak in organic farming protected cultivation has recently been detected with a high level of economic damage. In such situation major disruption of biological control programmes could be expected.
Degree of uncertainty	Key areas of uncertainty exist with the following: i) Potential synonymy with *T. takafujii* – if synonymy is proven, the area of the EPPO region suitable for establishment would increase, ii) Distribution of *T. evansi* e.g. within South America, Africa, Asia and the EPPO region. iii) Importance of potato tubers as pathways iv) No detections have been made so far on pathways involving plants for planting (Exported plants may be of higher quality) v) There is no good explanation as to why *T. evansi* does not go often inside glasshouses (may be due to cultivars with resistance) vi) Unknown volume and frequency of movement of solanaceous plants from the area where *T. evansi* occurs and the rest of the EPPO area. vii) Potential increase in production costs (amount of pesticide free production how much could be impacted) viii) Social impact ix) Rate of spread (How much spread could be caused by man.)
OVERALL CONCLUSIONS	The EWG considered that the pest was an appropriate candidate for pest risk management given the high potential for establishment and the potential for economic impact in particular in protected cultivation where biological control is in place.

STAGE 3: PEST RISK MANAGEMENT

IDENTIFICATION OF THE PATHWAYS

Pathways studied in the pest risk management	**Pathway 1: Plants for planting of Solanaceae except seeds likelihood of entry is medium so risk management should be envisaged.**
Other pathways identified but not studied	**Pathway 2: Fruits of *Solanaceae,* potato tubers for consumption and beans, likelihood of entry very low, no management options are suggested.** **Pathway 3: Hitchhiking on other plants for planting, likelihood of entry is very low to low, no management options are suggested. .**

IDENTIFICATION OF POSSIBLE MEASURES

Possible measures for pathways

Pathway 1: Plants for planting of *Solanaceae* except seeds.

Measures related to consignments:

Visual inspection + treatment of the consignment

Visual detection of mites is possible but confusion with other mites (such as *T urticae (syn. cinnabarinus), T. turkestani, T. ludeni, T. neocaledonicus, T. lombardini)* is possible. Mites and eggs in low numbers would be difficult to detect.

Chemical treatments (combining treatments targeting adults and eggs) may be recommended but their efficacy has to be verified by inspection.

Measures related to the crop or to places of production:

Pest Free Area for *T. evansi*

Pest Free Place of Production:

Mites are expected to spread more than five kilometres.

Having a five km buffer zone free from host plants is not a realistic option but a place of production freedom should consist in:

- Isolation: no other host plants in the immediate vicinity of the place of production (minimum 5 m Clark, 2001)
- Hygienic measures to prevent the pest to enter the greenhouse.
- Treatment of the crop during the production (the active ingredients which have resulted in more than 90% of mortality in adult females are: hexythiazox, propargite, dicofol, acrinatrin, fenbutatin oxide, dicofol+hexythiazox, fenpyroximate and dicofol[1].)
- Two inspections of the consignment prior to export

Other possible measures

Surveillance in the importing country was not considered as a possible measure.

[1] All these active ingredients are being re-evaluated for their authorization of use at the EU level.

EVALUATION OF THE MEASURES IDENTIFIED IN RELATION TO THE RISKS PRESENTED BY THE PATHWAYS

Degree of uncertainty

CONCLUSION:
Recommendation for possible measures:
PC= Phytosanitary certificate, RC=Phytosanitary certificate of re-export

Pathway 1:
Plants for planting of *Solanaceae* except seeds
	PC and, if appropriate, RC
	• Area freedom for *T. evansi*
	or
	• Place of production freedom for *T. evansi:*
	  o Isolation: no other host plants in the immediate vicinity of the place of production (minimum 5 m)
	  o Hygienic measures to prevent the pest to enter the greenhouse.
	  o Two inspections of the place of production at 2 weeks intervals prior to export
	or
	• treatment of the consignment and visual inspection immediately prior to export

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Appendix 1

MAXENT 2.3 has been used to determine the most likely distribution for *Tetranychus evansi* outdoors. The red colours indicate the best potential conditions for the pest