FORMAT FOR A PRA RECORD (version 3 of the Decision support scheme for PRA for quarantine pests)

	European and Mediterranean Plant Protection Organisation		
	Organisation Européenne et Méditerranéenne pour la Protection des Plantes		
	Guidelines on Pest Risk Analysis		
	Lignes directrices pour l'analyse du risque phytosanitaire		
	Decision-support scheme for quarantine pests Version N°3		
PEST RISK ANALYSIS FOR: ***Tetranychus evansi*** **Baker & Pritchard**			
Pest risk analyst:	EWG PRA *T. evansi*		**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** (CSL, 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),
Date:	2007-08-27/30		
Stage 1: Initiation			
1. What is the reason for performing the PRA?			The EPPO Secretariat was informed in early 2004 by the French NPPO that the spider mite species, *Tetranychus evansi* was spreading within Mediterranean countries. As *T. evansi* is considered as 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 considered that a PRA should be performed.

2. Enter the name of the pest		*T. evansi* Baker & Pritchard, 1960. Note that *T. takafujii* Ehara & Ohashi, 2002, described as a new species in Japan, is now suspected to be a synonym of *T. evansi* (Migeon, pers. com., 2007*)*
2A. Indicate the type of the pest		A spider mite that mainly infests hosts leaves.
2B. Indicate the taxonomic position		Acari, Tetranychidae
3. Clearly define the PRA area		EPPO member countries
4. Does a relevant earlier PRA exist?	Yes	A PRA was performed by Alan MacLeod (Central Science Laboratory, York, UK, 2005-09-22).
5. Is the earlier PRA still entirely valid, or only partly valid (out of date, applied in different circumstances, for a similar but distinct pest, for another area with similar conditions)?		The earlier PRA by MacLeod is partly valid as the PRA area is the United Kingdom.
Stage 2A: Pest Risk Assessment - Pest categorization		
6. Specify the host plant species (for pests directly affecting plants) or suitable habitats (for non parasitic plants) present in the PRA area.		*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.com. 2007), and *Rosa* spp. (Qureshi, *et al*. 1969). **Weeds** The preferred hosts for *T. evansi* are the widespread weed *Solanum nigrum* and *S. americanum* (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.
7. Specify the pest distribution		*T. evansi* is suspected to originate from South America but it has been unintentionally introduced to other parts of the world. For example, it was introduced into Mauritius then spread to Reunion in the 1970s (Gutierrez & Etienne, 1986). It was recorded in southern Africa in the 1980s and in northern Africa at the end of 1980s. It was first recorded in Portugal in 1991 (Ferreira & Carmona, 1995), Spain in 1995, France in 2004, Italy in 2005 and Israel in 2006 (Moraes *et al.*, 1987; Ferragut & Escudero, 1999; EPPO, 2004; Migeon, 2007). 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 overlooked on non-crop plants. See Migeon & Dorkeld (2007) for map and country list.

		EPPO region: France (Pyrénées-Orientales, Alpes Maritimes, Var), Greece (EPPO, 2007), Israel (EPPO, 2006), Italy (Liguria, EPPO 2006), Jordan (Palevsky, pers. com. 2007), Portugal (from Algarve to Lisbon including Madeira) (Ferragut, pers.com. 2007 for the details of distribution in Portugal), Spain (Canary Islands, Balearic Islands, along the Mediterranean coast, Atlantic coast of Andalusia) (Ferragut, pers.com. 2007 for the details of distribution in Spain). **Asia**: Israel (EPPO, 2006), Jordan (Palevsky, pers. com. 2007), Taiwan (including Kinmen and Lienchang Islands). If *T. takafujii* is shown to be a synonym of *T. evansi*, then the pest also occurs in Japan. **Africa:** Democratic Republic of Congo, Congo, Gambia, Kenya, Malawi, Mauritius (including Rodrigues island), Morocco, Mozambique, Namibia, Niger (Migeon, pers. com. 2007), Reunion Island, Senegal, Seychelles, Somalia, South Africa, Tunisia, Zambia, Zimbabwe. Detection of *T. evansi* on consignments of plant products from Gambia, suggests that *T. evansi* may also be present in Gambia (A Macleod, pers. com. 2007). **North America:** USA (Arizona, California, Florida, Texas, Hawaii). **Central America and Caribbean**: Puerto Rico, Virgin Islands **South America**: Brazil, Argentina **Oceania:** Hawaii (USA).
8. Is the organism clearly a single taxonomic entity and can it be adequately distinguished from other entities of the same rank?	Yes	Although non-specialists would find it difficult to identify this species (confusion with other mites such as *T. urticae* (syn. *cinnabarinus*), *T. turkestani*, *T. ludeni*, *T. neocaledonicus, T. lombardini* is possible), it can be distinguished from other *Tetranychus* species both morphologically and with molecular methods (Knapp *et al.* 2003). Nevertheless, there is uncertainty about the taxonomic status of *T. takafujii* that is suspected to be a synonym of *T. evansi* by European acarologists (Migeon, pers.com.

		2007).
9. Even if the causal agent of particular symptoms has not yet been fully identified, has it been shown to produce consistent symptoms and to be transmissible?		
10. Is the organism in its area of current distribution a known pest (or vector of a pest) of plants or plant products?	Yes	Reports of damage come from Africa (Fiaboe *et al.*, 2007), Spain (Ferragut & Escudero, 1999) and Israel (Ben David *et al.* 2007).
11. Does the organism have intrinsic attributes that indicate that it could cause significant harm to plants?		
12 Does the pest occur in the PRA area?	Yes	Within the EPPO region, *T. evansi* occurs in Spain (Canary Isles, Balearic Isles, along the Mediterranean coast, the Atlantic coast of Andalousia), Portugal (including Madeira), France (Pyrénées-Orientales, Alpes Maritimes, Var), Greece (EPPO, 2007), Italy, Israel, Jordan, Tunisia and Morocco.
13. Is the pest widely distributed in the PRA area?	No	Within the PRA area, *T. evansi* is only reported from the Mediterranean regions (see above). Within the Mediterranean regions, there are some countries where the pest has not been recorded.
14. Does at least one host-plant species (for pests directly affecting plants) or one suitable habitat (for non parasitic plants) occur in the PRA area (outdoors, in protected cultivation or both)?	Yes	The preferred host (*S. nigrum*) and at least three major cultivated hosts (aubergines, tomatoes and potatoes) are widely distributed in EPPO member countries. Many other hosts are present/grown in the PRA area.
15. If a vector is the only means by which the pest can spread, is a vector present in the PRA area? (if a vector is not needed or is not the only means by which the pest can		

spread go to 14)		
16. Does the known area of current distribution of the pest include eco-climatic conditions comparable with those of the PRA area or sufficiently similar for the pest to survive and thrive (consider also protected conditions)?	Yes	The known ecoclimatic conditions in the area of current distribution include tropical and Mediterranean climatic conditions. *T. evansi* is reported in some areas of the Mediterranean region. There are parts of the PRA area with Mediterranean eco-climatic conditions, where *T. evansi* has not been reported. In addition, if *T. takafujii* is a synonym of *T. evansi*, then the area with suitable eco-climatic conditions in the PRA area would increase.
17. With specific reference to the plant(s) or habitats which occur(s) in the PRA area, and the damage or loss caused by the pest in its area of current distribution, could the pest by itself, or acting as a vector, cause significant damage or loss to plants or other negative economic impacts (on the environment, on society, on export markets) ?	Yes	Damage has been recorded on outdoor grown tomatoes, beans and aubergines in Africa (Keizer & Zuurbier, 2001), Portugal (Ferreira & Carmona, 1995) and Spain (Ferragut & Escudero, 1999) and on outdoor grown aubergines and potatoes in Israel (Ben David *et al.* 2007). These crops occur either outdoors or in protection throughout the PRA area.
18. This pest could present a risk to the PRA area.		

Section 2B: Pest Risk Assessment - Probability of introduction/spread and of potential economic consequences

Note: If the most important pathway is intentional import, do not consider entry, but go directly to establishment. Spread from the intended habitat to the unintended habitat, which is an important judgement for intentionally imported organisms, is covered by questions 1.33 and 1.35.		

1.1 Consider all relevant pathways and list them		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* (e.g. tomato plants, seed potato tubers, and ornamentals including potted plants) except seeds; No interceptions have been recorded. Regarding potato tubers, one instance of introduction on potato tubers for planting was noted in Israel with tubers imported from South America in a research quarantine station the mites were confirmed as *T. evansi* (Palevsky, pers. com. 2007). 2. *T. evansi* on host plant produce e.g. tomato fruit, including tomatoes “on the vine”, aubergine fruit and beans; The finding on seed potato tubers also indicates a possibility that potato tubers for consumption can be a pathway as well. 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. com. 2007). I 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. This involves the succession of events and the probability was considered very low but the EWG did not want to eliminate this pathway at this stage.

		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 has been 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.
1.2 Estimate the number of relevant pathways, of different commodities, from different origins, to different end uses.	**Moderate number** Medium uncertainty	Although precise data is not available, it is known that a variety of host produce is imported by countries in the PRA area e.g. tomatoes, aubergines, beans and potatoes, from countries where *T. evansi* is present e.g. Kenya, Tunisia, Morocco, Israel, Italy, Spain and France. Hence the number of pathways was considered to be moderate with a medium level of uncertainty.
1.3. Select from the relevant pathways, using expert judgement, those which appear most important. If these pathways involve different origins and end uses, it is sufficient to consider only the realistic worst-case pathways. The following group		There is no information on which pathway(s) the pest was introduced to new areas. The most likely way of introduction is supposed to be with infested solanaceous plants for planting and subsequently locally spread by wind. At the moment, where the pest is present in Israel and Spain, there are no reports of economic damage to protected tomato crops.

of questions on pathways is then considered for each relevant pathway in turn, as appropriate, starting with the most important.		The EWG consequently considered the following pathways: P1: Plants for planting of *Solanaceae* except seeds P2: Fruits of *Solanaceae*. *T. evansi* has been intercepted several times on aubergine in the United Kingdom. P3: Hitchhikers on other plants for planting (except seeds). If plants for planting are cultivated in the neighbourhood of a field infested with *T. evansi* these plants for planting could be infested.
Pathway n°: 1		Plants for planting of Solanaceae except seeds
P1 **1.4 How likely is the pest to be associated with the pathway at origin taking into account factors such as the occurrence of suitable life stages of the pest, the period of the year?**	**Moderately likely** Low uncertainty	The EWG assumed that *T. evansi* has spread internationally via plants for planting. In EPPO countries where the pest is present, no outbreaks have been reported on propagation material. Furthermore spider mites reproduce better on mature leaves (Kielkiewicz, 1996) that are less likely to be transported as propagating material. Nevertheless, in countries of origin, many weeds are a good reservoir and are often found contaminated in the vicinity of places of production (Palevski and Ferragut, pers communication 2007). The EWG concluded that the pest is moderately likely to be associated with the pathway at origin.
P1 **1.5 How likely is the concentration of the pest on the pathway at origin to be high, taking into account factors like cultivation practices, treatment of consignments?**	**Unlikely** Low uncertainty	Existing cultural practices and pest control regimes e.g. for *Tetranychus urticae* in companies producing plants for planting of *Solanaceae* (e.g. tomato plants) means that plants are likely to be treated.
P1 1.6 How large is the volume of the movement along the pathway?	**Low** Medium	Data on specific hosts is lacking. EU countries imported 1,156 tonnes of indoor rooted cuttings and 688 tonnes of outdoor rooted cuttings from Brazil, Kenya, South Africa, USA & Zimbabwe (countries outside

	uncertainty	the PRA area where *T. evansi* is present) between 2002 and 2006 (EU Comext CD, disc S2, 2007) 2007), however, import of plants of Solanaceae intended for planting from these countries is prohibited in the EU. Over the same period EU countries shipped 25,426 tonnes of indoor rooted cuttings and 17,515 tonnes of outdoor rooted cuttings from France, Israel, Italy, Morocco, Portugal, Spain and Tunisia (countries inside the PRA area where *T. evansi* is present) (EU Comext data). Thus, between 22 and 25 times more material (cuttings and young plants, some of which could carry *T. evansi*) is shipped within the PRA area than is imported into the PRA area. Import of seed potato tubers is usually prohibited from non European countries, but trade is allowed within European countries. It is noted that tomato is mainly imported as seeds, but internal movement of seedlings from Spain, France and Portugal does occur. Compared with produce such as Citrus, of which 3.2 million tonnes were imported from Brazil, Kenya, South Africa, USA & Zimbabwe between 2002 and 2006, the volume of movement on this pathway is moderate.
P1 1.7 How frequent is the movement along the pathway?	**Often** Medium uncertainty	It is assumed that consignments arrive every month of the year (for movements between countries within the EPPO region) .
P1 1.8 How likely is the pest to survive during transport /storage?	**Likely** Low uncertainty	It is likely that plants are transported in cool conditions. Any mites infesting the plants will become quiescent if cooled thus transport or storage conditions will not affect the mite too negatively.
P1 1.9 How likely is the pest to multiply/increase in prevalence during transport /storage?	**Very unlikely** Low uncertainty	Transport and storage temperatures are usually cool and the lower temperature threshold for this pest is reported as 10.3°C (Bonato, 1999) although based on data provided in Moraes & McMurtry (1987) it could be 13.2°C. *T. evansi* can survive at lower temperatures but no reproduction or development takes place (Bonato, 1999).

P1 1.10 How likely is the pest to survive or remain undetected during existing management procedures (including phytosanitary measures)?	**Very likely** Low uncertainty	The concentration of the pest is expected to be low (because mites do not have time to build up high populations on young plants) so detection is difficult, although in principle the mites and their eggs can be seen with a naked eye. Even if detected, the mite may be confused with other, unregulated spider mite species.
P1 1.11 How widely is the commodity to be distributed throughout the PRA area?	**Very widely** Low uncertainty	Host plants are grown across the EPPO region both outdoors and in protected cultivation.
P1 1.12 Do consignments arrive at a suitable time of year for pest establishment?	**Yes**	Indoor cuttings will be maintained in protected environments (glasshouses / polytunnels) some of which may be heated. In such conditions, temperature is almost always going to be suitable for pest establishment. Outdoors, temperatures are usually suitable in the Mediterranean region at all times. For example, small tomato plants are usually transplanted outdoors in this region when the minimum temperature is around 15°C, this will not limit the establishment of *T. evansi*.
P1 1.13 How likely is the pest to be able to transfer from the pathway to a suitable host or habitat?	**Very likely** Low uncertainty	In this case the pest is already on a suitable host. Infested plants for planting are likely to be grouped close to other suitable (or the same) hosts to which *T. evansi* could transfer.
P1 1.14 How likely is the intended use of the commodity (e.g. processing, consumption, planting, disposal of waste, by-products) to aid transfer to a suitable host or habitat?	**Very likely** Low uncertainty	The intended use of the plants is planting. This aids transfer (see answer to Q1.13)
P1 1.15 Do other pathways need to be considered?	**Yes**	
Pathway n°: 2		**Fruits of *Solanaceae* , potato tubers for consumption and beans.**

P2 1.4 How likely is the pest to be associated with the pathway at origin taking into account factors such as the occurrence of suitable life stages of the pest, the period of the year?	**Moderately Likely** Low uncertainty	*T. evansi* has been detected on consignments of aubergine fruit from Kenya on a number of occasions since 2005 (CSL unpublished data, 2007). No information is available for beans. There is only one reported finding on seed potato tubers that indicate the potential for tubers to act as a pathway but no specific information is available. The primary host, *S. nigrum*, is widely distributed in countries at origin and can often be found in the vicinity of places of production. *T. evansi* occurs widely in the areas of origin and is moderately likely to be associated with the pathway.
P2 1.5 How likely is the concentration of the pest on the pathway at origin to be high, taking into account factors like cultivation practices, treatment of consignments?	**Unlikely** Low uncertainty	Spider mites are not found in high numbers on fruits. Mites such as *T. evansi* are more likely to occur at higher concentrations on peduncles and leaves. These could be transported with fruits especially tomatoes "grown on the vine". However, treatments are usually applied on these crops although they are usually not done close to harvest. .
P2 1.6 How large is the volume of the movement along the pathway?	**Major** Low uncertainty	EU member states imported a total of 156,473 tonnes of beans; 2,761 tonnes aubergines and 1,676 tonnes of fresh or chilled tomatoes from Brazil, Kenya, Mauritius, Mozambique, Namibia, South Africa, USA, Zambia & Zimbabwe (countries outside the PRA area where *T. evansi* is present) between 2002 and 2006 (EU Comext data, 2007). Over the same period, EU countries shipped 877,776 tonnes of beans, 459,381 t of aubergines and 6,538,513 t of tomatoes from France, Israel, Italy, Morocco, Portugal, Spain and Tunisia (countries inside the PRA area where *T. evansi* is present) (EU Comext data). Import of potato tubers for consumption is restricted from non European countries, but trade is allowed within European countries and Mediterranean countries where the pest is present (448,000 t of potatoes are exported from Algeria, Israel, Morocco and Tunisia to the EU).
P2 1.7 How frequent is the movement along the pathway?	**Often** Low uncertainty	Consignments arrive all year round (EU Comext data).

P2 1.8 How likely is the pest to survive during transport /storage?	**Likely** Low uncertainty	It is likely that produce is transported in cool conditions. Any mites infesting the produce will become quiescent if cooled thus transport or storage conditions will not affect the mite too negatively.
P2 1.9 How likely is the pest to multiply/increase in prevalence during transport /storage?	**Very unlikely** Low uncertainty	Transport and storage temperatures are usually cool and the lower temperature threshold for this pest is between 10.3°C (Bonato, 1999) and 13.2°C (Moraes & McMurtry, 1987) . *T. evansi* can survive at lower temperatures but no reproduction or development takes place (Moraes & McMurtry 1987).
P2 1.10 How likely is the pest to survive or remain undetected during existing management procedures (including phytosanitary measures)?	**Very likely** Low uncertainty	The concentration of the pest is expected to be low (because of treatments and also given the fact that spider mites are not found in high numbers on fruits see P2 1.5)) so detection is difficult, although in principle the mites and their eggs can be seen with a naked eye. Even if detected, the mite may be confused with other, unregulated spider mite species.
P2 1.11 How widely is the commodity to be distributed throughout the PRA area?	**Very widely** Low uncertainty	Tomato, potato, beans and aubergine are distributed across the entire EPPO region for public consumption.
P2 1.12 Do consignments arrive at a suitable time of year for pest establishment?	**Yes**	Consignments arrive all year round and when they arrive in the summer, the climate in parts of the PRA area is most suitable for establishment.
P2 1.13 How likely is the pest to be able to transfer from the pathway to a suitable host or habitat?	**Unlikely** Low uncertainty	Fruits or potato tubers are unlikely to come into contact with host plants. However, some sites of tomato, aubergine or bean production have adjacent packing stations. At times of the year when domestic production declines i.e. in the autumn/winter and until spring, produce is imported to the packing house to keep the packing station working and to maintain a constant supply route to major retailers (this may be he case in the northern EPPO countries and fruits may come from Northern EPPO countries) . This increases the likelihood of transfer to a suitable host although conditions in winter are not very suitable to a mite active behaviour.
P2 1.14 How likely is the intended use of the commodity (e.g. processing, consumption, planting, disposal of waste,	**Very unlikely** Low	Fruit are for consumption. However, note the comment to P2 1.13 above.

by-products) to aid transfer to a suitable host or habitat?	uncertainty	
P2 1.15 Do other pathways need to be considered?	**Yes**	
Pathway n°: 3		**Hitchhiking on plants for planting (except seeds) other than *Solanaceae***
P3 1.4 How likely is the pest to be associated with the pathway at origin taking into account factors such as the occurrence of suitable life stages of the pest, the period of the year?	**Unlikely** Low uncertainty	The primary host, *S. nigrum*, is widely distributed in countries at origin and can often be found in the vicinity of places of plant production. *T. evansi* occurs widely in the areas of origin but is unlikely to be associated with the pathway since although the pest could land on a non-host plant, it is not likely to remain there for very long (Palevsky, pers. com. 2007)
P3 1.5 How likely is the concentration of the pest on the pathway at origin to be high, taking into account factors like cultivation practices, treatment of consignments?	**Very unlikely** Low uncertainty	Since it is unlikely that *T. evansi* would remain for long on a non-host plant, the concentration of the pest is likely to be low. Only mites landing on non-host plants immediately prior to their packing and shipping would remain on the plant, but they would not multiply on such non-host plants. Nevertheless, *T. urticae* is known to 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).
P3 1.6 How large is the volume of the movement along the pathway?	**Moderate** Medium uncertainty	Data on specific hosts is lacking. However, EU countries imported 1,156 tonnes of indoor rooted cuttings and 688 tonnes of outdoor rooted cuttings from Brazil, Kenya, South Africa, USA & Zimbabwe (countries outside the PRA area where *T. evansi* is present) between 2002 and 2006 (EU Comext data, 2007). Over the same period EU countries shipped 25,426 tonnes of indoor rooted cuttings and 17,515 tonnes of outdoor rooted cuttings from France, Israel, Italy, Morocco, Portugal, Spain and Tunisia (countries inside the PRA area where *T. evansi* is present) (EU Comext data). Thus, between 22 and 25 times more material (cuttings and young plants, some of which could carry *T. evansi*) is shipped within the PRA area than is imported into the PRA area.

		Compared with produce such as Citrus, of which 3.2 million tonnes were imported from Brazil, Kenya, South Africa, USA & Zimbabwe between 2002 and 2006, the volume of movement on this pathway is moderate.
P3 1.7 How frequent is the movement along the pathway?	**Often** Medium uncertainty	Consignments are assumed to arrive all year round.
P3 1.8 How likely is the pest to survive during transport /storage?	**Likely** Low uncertainty	It is likely that plants are transported in cool conditions. Any mites infesting or hitchhiking on the plants will become quiescent if cooled thus transport or storage conditions will not affect the mite negatively.
P3 1.9 How likely is the pest to multiply/increase in prevalence during transport /storage?	**Very unlikely** Low uncertainty	The pest could not multiply on non-host plants.
P3 1.10 How likely is the pest to survive or remain undetected during existing management procedures (including phytosanitary measures)?	**Very likely** Low uncertainty	The concentration of the pest is expected to be low (because of treatments and because the mites are transferring to the plants just by accident) so detection is difficult, although in principle the mites can be seen with a naked eye. Even if detected, the mite may be confused with other, unregulated spider mite species.
P3 1.11 How widely is the commodity to be distributed throughout the PRA area?	**Very widely** Low uncertainty	Plants for planting are imported then distributed throughout the EPPO region
P3 1.12 Do consignments arrive at a suitable time of year for pest establishment?	**Yes**	Indoor plants will be maintained in protected environments (glasshouses / polytunnels) some of which may be heated. In such conditions, temperature is almost always going to be suitable for pest establishment. Outdoors, temperatures are usually suitable around the border of the Mediterranean region at all times.

P3 1.13 How likely is the pest to be able to transfer from the pathway to a suitable host or habitat?	**Unlikely** High uncertainty	Because any initial population of *T. evansi* on non-host plants are assumed to be present in low numbers and in weak condition, the probability that any *T. evansi* will find a suitable host is considered very low although weed hosts at the destination can be widespread (e.g. *S. nigrum*). *T. evansi* infesting seedlings of outdoor plants would probably find it easier to transfer to suitable hosts than mites infesting plants meant for glasshouses / polytunnels. Nevertheless such transfer was considered having a low probability.
P3 1.14 How likely is the intended use of the commodity (e.g. processing, consumption, planting, disposal of waste, by-products) to aid transfer to a suitable host or habitat?	**Unlikely** Low uncertainty	Pathways involving plants for planting usually aid transfer but these are non-host plants for planting, thus *T. evansi* would have to transfer to a suitable host plant. The EWG thought that the main Solanaceous crops affected (i.e. main hosts) would not be maintained close to non Solanaceous plants (i.e. non-host plants), thus making transfer unlikely.
P3 1.15 Do other pathways need to be considered?	**No**	

Conclusion on the probability of entry ***Liklelihood of entry presented by different pathways***		Although the mite has already entered the EPPO region, the probability of entry is considered to be low and the likelihood of further entry with the pathways identified is low. P1: Plants for planting of Solanaceae except seeds. Likelihood of entry = low to medium. Although it is considered as the most likely pathway the likelihood was considered as low to medium as most of the answers given in the entry section indicate a low to medium likelihood. At the moment the experience in EPPO countries where *T. evansi* is present is that the likelihood of infestation of a crop resulting from the introduction of infested solanaceous plant material is low to medium. P2. Fruits of *Solanaceae* potato tubers and beans. Likelihood of entry = very low P3. Hitchhiking on plants for planting (except seeds) other than *Solanaceae.* Likelihood of entry = very low to low
1.16. Estimate the number of host plant species or suitable habitats in the PRA area (see question 6).	**Many** Low uncertainty	*T. evansi* is a polyphagous species preferring to feed on wild and cultivated Solanaceae. (see question 6)
1.17 How widely distributed are the host plants or suitable habitats in the PRA area? (specify)	**Very widely**	Host plants are grown both outdoors and under protected cultivation in all EPPO member countries
1.18 If an alternate host or another species is needed to complete the life cycle or for a critical stage of the life cycle such as transmission (e.g. vectors), growth (e.g. root symbionts), reproduction (e.g. pollinators) or spread (e.g. seed dispersers), how likely is the pest to come in contact with such species?		

1.19 Does the pest require other species for critical stages in its life cycle such as transmission, (e.g. vectors), growth (e.g. root symbionts), reproduction (e.g. pollinators) or spread (e.g. seed dispersers) ?		
1.19A Specify the area where host plants (for pests directly affecting plants) or suitable habitats (for non parasitic plants) are present (cf. QQ 1.16-1.19). This is the area for which the environment is to be assessed in this section. If this area is much smaller than the PRA area, this fact will be used in defining the endangered area.		All EPPO member countries
1.20 How similar are the climatic conditions that would affect pest establishment, in the PRA area and in the current area of distribution?	**Very similar** Low uncertainty	*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 distribution of the pest. Moraes and 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

Table 1: Threshold temperatures for development of *Tetranychus evansi* life stages

Life stage	Threshold temperature for	Degree Days required

	development	for development
Egg	13.2	62
Larva	13.2	36
Protonymph	12.9	25
Deutonymph	12.6	33
Combined immature stages	13.2	148
Adult maturation (preoviposition)	13.7	10

Based on the data in the table above, *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).

In protected conditions, based on 148 degree day required above a threshold of 13.2°C (Moraes & McMurtry, 1987) daily records of maximum and minimum temperatures from a heated UK glasshouse, where the minimum recorded temperature during the year was 8.2°C (the mean daily minimum was 16.1°C) and the maximum recorded temperature was 34.2°C (the mean daily maximum was 24.2°C) CSL data (unpublished) suggests that *T. evansi* could very easily survive, year round, with perhaps ten to 15 generations in a heated glasshouse through the year. It could also survive year round in an unheated glasshouse, with perhaps 3 or 4 generations per year. Similar conditions also exist in northern part of the EPPO region.

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, *T. evansi* would be able to thrive on hosts in heated glasshouses everywhere in the EPPO region.

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 the *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.
1.21 How similar are other abiotic factors that would affect pest establishment, in the PRA area and in the current area of distribution?		No other abiotic factors were thought to affect establishment.
1.22 How likely is it that establishment will occur despite competition from existing species in the PRA area?	**Very likely** Low uncertainty	*T. evansi* is likely to establish in the PRA area despite potential competition from existing mites. In Spain, studies have shown that *T. evansi* has established on weed hosts despite competition with *T. urticae* (Ferragut, pers. com. 2007).
1.23 How likely is it that establishment will occur despite natural enemies already present in the PRA area?	**Very likely** Low uncertainty	*T. evansi* has established and spread within the PRA area. No natural enemies are known to inhibit the spread of *T. evansi.* In production systems where biological control agents such as the predatory mites *Phytoseiulus persimilis* and *Neoseiulus californicus* are used they are not effective against *T. evansi* (Escudero & Ferragut, 2005; Moraes & McMurtry, 1987).
1.24. To what extent is the managed environment in the PRA area favourable for establishment?	**Highly Favourable** Low uncertainty	Some of the host plants (aubergines, beans, potatoes and tomatoes) are grown, hence available, within the PRA area year round (either outside on in protected cultivation). This would favour the establishment of the pest.
1.25 How likely is it that existing pest management practice will fail to prevent establishment of the pest?	**Likely** Low uncertainty	*T. evansi* has established and spread within the PRA area, despite existing pest management practices. *T. evansi* can survive on weed-hosts which might not be managed. In crops where acaricides are used, such practices may prevent establishment. Acaracides are presently very effective against *T. evansi* but resistance may develop as has been the case for *T. urticae*. As noted in 1.23 biological control is not effective.
1.26. Based on its biological characteristics, how likely is it that the pest could survive eradication	**Very likely** Low uncertainty	<u>For Mediterranean climate areas:</u> Very likely. There have been no reports of *T. evansi* (or other Tetranychidae species) being eradicated outdoors following their introduction into new areas .

programmes in the PRA area?	**Very unlikely** Low uncertainty	Under protected conditions outside the Mediterranean climatic area: Very unlikely. It would be possible to eradicate *T. evansi* from protected cultivation, for example using i) chemical applications, ii) crop destruction, iii) heating of the glasshouse to 50°C for two to three days, iv) implementing a crop break for at least 4 weeks whilst ensuring no host-weeds were present to act as a "bridge". There are some glasshouses having a whole year production systems. In such cases the pest could be more difficult to eradicate (e.g. in Finland 20 % of the tomato area (total 116 ha) and 25% of cucumber area (tot. 73 ha) are grown year-round)
1.27. How likely is the reproductive strategy of the pest and the duration of its life cycle to aid establishment?	**Likely** Low uncertainty	High fecundity. Development time is 13.6 days at 22°C and 6.3 days at 36°C allowing several generations per year if conditions are suitable. Some mites, such as *T. urticae* can enter diapause to survive harsh conditions. This strategy would aid establishment potential, but *T. evansi* has no such ability.
1.28 How likely are relatively small populations to become established?	**Very likely** Low uncertainty	One tetranychid female is enough to establish a population as its fecundity is very high (Tetranychidae characteristics) and are generally mated just after emeregence (Bonato, 1999; Moraes & McMurtry, 1987)
1.29. How adaptable is the pest?	**Medium adaptability** Medium uncertainty	In the 1960s-80s *T. evansi* developed resistance to organophosphates, as did many other Tetranychidae. No other resistance has been reported since. If *T. takafujii* is confirmed as a synonym of *T. evansi*, its ability to establish in the cooler climate of Japan is further evidence of its adaptability. Uncertainty lies in drawing evidence from other Tetranychidae.
1.30 How often has the pest been introduced into new areas outside its original area of distribution? (specify the instances, if possible)	**Often**	The pest is suspected to originate from South American origins and has been introduced into USA, Africa, Asia and Europe.

1.31 If establishment of the pest is very unlikely, how likely are transient populations to occur in the PRA area through natural migration or entry through man's activities (including intentional release into the environment)?		Establishment has occurred.
Summarize the potential for establishment		Probability of establishment is high
1.32 How likely is the pest to spread rapidly in the PRA area by natural means?	**Moderately likely** Low uncertainty	Natural spread is not likely to cause rapid spread. Most spread is likely to occur locally (e.g. wind).
1.33 How likely is the pest to spread rapidly in the PRA area by human assistance?	**Likely** High uncertainty	Trade of infested host plants for planting can ensure spread. *T. evansi* has already spread in the PRA area but there is no evidence on how the pest has spread. It is suspected that spread resulted from a combination of human assistance (transport of infested plants for planting, workers through clothing and tools) and wind for further local spread.
1.34 Based on biological characteristics, how likely is it that the pest will not be contained within the PRA area?	**Very likely** Low uncertainty	*T. evansi* is small, has many hosts, including widely distributed weeds, and can easily be confused with other widespread mites. In the area where the climatic conditions are suitable outdoors, there is no possibility to contain *T. evansi*. Where *T. evansi* is present already there has been no success in containment.
The overall probability of introduction and spread should be described. The probability of introduction and spread may be expressed by comparison with PRAs on other pests.		*T. evansi* has already been introduced to the PRA area and has spread in the Mediterranean part of the EPPO region. The probability of entry is low The probability of establishment is high. Probability of spread is high in particular in Mediterranean regions.

		The overall probability is medium to high
1.35. Based on the answers to questions 1.16 to 1.34 identify the part of the PRA area where presence of host plants or suitable habitats and ecological factors favour the establishment and spread of the pest to define the endangered area.		The endangered area is the whole area of EPPO countries (only in protected conditions for areas where the pest cannot establish outdoors).
2.0 In any case, providing replies for all hosts (or all habitats) and all situations may be laborious, and it is desirable to focus the assessment as much as possible. The study of a single worst-case may be sufficient. Alternatively, it may be appropriate to consider all hosts/habitats together in answering the questions once. Only in certain circumstances will it be necessary to answer the questions separately for specific hosts/habitats.		
2.1 How great a negative effect does the pest have on crop yield and/or quality to cultivated plants or on control costs within its current area of distribution?	**Moderate** Medium uncertainty	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.com. 2007) although specific losses in crop yield have not been quantified. Infested tomato plants turn yellow, green then brown. Plants generally show a bleached yellow-orange or russeted appearance. Mites may kill their host very rapidly (Jeppson *et al.*, 1975). In Zimbabwe,

		up to 90% yield losses in tomato crops 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 and Ferragut, 2005), although there is no specific data on economic impact caused by *T. evansi* alone (Ferragut, pers. com., 2007). In Spain, damage has only been recorded in outdoor crops such as aubergine, potato and tomato (Ferragut, pers. com., 2007) the same situation occurring in Israel on aubergine and potato. The most severe damage in Israel occurs on aubergine (Palevsky pers.com., 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. At the time of the meeting (August 2007) 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. com., 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 hypothesis 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 shown to be more damaging in Africa than in Europe. In the US the pest was detected in the 1950's but no economic damage is recorded now. It is recorded in Brazil that the effectiveness of *Euseius concordis* (Chant) a predator of *Aculops lycopersici* (tomato russet mite) was limited by the presence of *T. evansi*, the problem being with the webbing of *T. evansi* inhibiting its activity (Moares & Lima, 1983).
2.2 How great a negative effect is the pest likely to have on crop yield and/or quality in the PRA area without any control	**Moderate** Medium uncertainty	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.

measures?		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.com. 2007).

2.3 How easily can the pest be controlled in the PRA area without phytosanitary measures?	**Easily** Medium uncertainty	For the moment current acaricides control *T. evansi* but it may develop resistance (as it did to organophosphates in Africa (Blair, 1989)) and as other Tetranychids species have done so. The current commercially available biological control agents are not effective. The species is present on weeds such as *Solanum nigrum*. There is no information on whether tomato cultivars used in protected conditions are resistant to *T. evansi* (Gonçalves *et al.*, 2006).
2.4 How great an increase in production costs (including control costs) is likely to be caused by the pest in the PRA area?	**Moderate** Medium uncertainty	Current plant protection products are efficient and additional treatments are not required (assuming that no resistance develops). In agricultural systems where biological control agents are used, plant protection products would have to be used to control *T. evansi* biological control would be disrupted and costs would consequently increase. IPM programmes would have to be adapted to incorporate control methods for *T. evansi*. Detection of the pest is not easy and it will require identification by an expert. The increase for producers using classical chemical protection is likely to be minor, whereas it would be expected to be major for producers using biological control agents. The cultivated tomato, *Lycopersicon esculentum*, is one of the most important vegetables in the European Union. Glasshouses, plastic houses and screen houses with tomato occupy 42,000 ha of which 34,000 ha (81%) are in southern Europe. (EU, 2006). Biologically-based Integrated Pest Management (IPM-Biocontrol) is common practice in tomato production in North-West Europe. Whereas in southern Europe less than 10% of the tomato production utilize IPM-Biocontrol, mainly because of the lack of effective natural enemies for whiteflies, found in the south all year around but not in the North. In Southern Europe 4,000 ha of vegetable production (representing 10% of the total production area) utilize IPM-Biocontrol (Ms Vanninen pers. comm., 2007). For potato crops (mainly for the Mediterranean part of the region) additional treatments for mites might be needed. Potato growers in Israel and Spain treat against spider mites if necessary (Palevski pers. com., 2007, Ferragut pers. com., 2007). Until now only sporadic treatments have been applied. Due to strict controls on residues, if the number of treatments increased the

		saleability of crops could be in danger.
2.5 How great a reduction in consumer demand is the pest likely to cause in the PRA area?	**Minimal** Low uncertainty	Except for heavy infestations, the pest does not directly affect the fruit quality.
2.6 How important is environmental damage caused by the pest within its current area of distribution??	**Minimal** Low uncertainty	The importance of the environmental impact of this species is not known. In Spain, ongoing displacement of *T. urticae* on weeds has been noted but no impacts seem to have occurred on predatory mites (Ferragut *et al.*, 2007). *T. evansi* can kill individual *Solanum nigrum* plants but the environmental importance of this plant is minor.
2.7 How important is the environmental damage likely to be in the PRA area (see note for question 2.6)?	**Minimal** Low uncertainty	See 2.6 above
2.8 How important is social damage caused by the pest within its current area of distribution?	**Minimal** Low uncertainty	No social impacts are reported within its current area of distribution.
2.9 How important is the social damage likely to be in the PRA area?	**Minor** Low uncertainty	In a worst case scenario (development of wide-spread resistance, establishment in production units relying on biological controls), there could be a social impact that could be moderate but under the current situation, the impact is likely to be minor.

2.10 How likely is the presence of the pest in the PRA area to cause losses in export markets?	**Unlikely** Low uncertainty	According to available information, *T. evansi* is a regulated pest in New Zealand only. It is mentioned in the Solanum (potato) health standard.
As noted in the introduction to section 2, the evaluation of the following questions may not be necessary if the responses to question 2.2 is "major" or "massive" and the answer to 2.3 is "with much difficulty" or "impossible" or any of the responses to questions 2.4, 2.5, 2.7, 2.9 and 2.10 is "major" or "massive" or "very likely" or "certain". You may go directly to point 2.16 unless a detailed study of impacts is required or the answers given to these questions have a high level of uncertainty.		
2.11. How likely is it that natural enemies, already present in the PRA area, will not reduce populations of the pest below the economic threshold?	**Very likely** Low uncertainty	Biological control with predatory mites such as *Phytoseiulus persimilis* and *Neoseiulus californicus* is not effective.
2.12. How likely are control measures to disrupt existing biological or integrated systems for control of other pests or to have negative effects on the environment?	**Very likely** Low uncertainty	Existing commercially available biological control agents are not effective against *T. evansi*. Plant protection products would have to be used disturbing the balance of IPM/biological control. IPM strategies would have to be revised.
2.13. How important would other costs resulting from introduction be?	**Minor** Low uncertainty	Costs for research and information. In Europe and Israel, research programs have already been initiated by biological control companies to find suitable biological control agents against *T. evansi*. Because *T. evansi* is difficult to detect information should be provided to growers. However, compared with other pests, such as *Bemisia tabaci*, *Diabrotica virgifera* and *P. ramorum*, other costs resulting from establishment of *T. evansi* are expected to be low. No great costs are reported from Spain, Italy or Portugal.
2.14. How likely is it that genetic traits can be carried to other species, modifying their genetic nature and making them		Not applicable

more serious plant pests?		
2.15A How likely is the pest to cause a significant increase in the economic impact of other pests by acting as a vector or host for these pests?		
2.16 Referring back to the conclusion on endangered area (1.35), identify the parts of the PRA area where the pest can establish and which are economically most at risk.		Most at risk are tomatoes, aubergines and potatoes grown outdoors in the Mediterranean part of the region and tomatoes and aubergines grown under protected cultivation elsewhere.
2.16A Estimation of the probability of introduction of a pest and of its economic consequences involves many uncertainties. In particular, this estimation is an extrapolation from the situation where the pest occurs to the hypothetical situation in the PRA area. It is important to document the areas of uncertainty (including identifying and prioritizing of additional data to be collected and research to be conducted) and the degree of uncertainty in the assessment, and to indicate where expert judgement has been used. This is necessary for transparency and may also be useful for identifying and prioritizing research needs. **It should be noted that the assessment of the probability and consequences of environmental hazards of pests of**		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 go 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 organic farming production, how much could be impacted) viii) Social impact ix) Rate of spread (How much spread could be caused by man.)

uncultivated plants often involves greater uncertainty than for pests of cultivated plants. This is due to the lack of information, additional complexity associated with ecosystems, and variability associated with pests, hosts or habitats.		
Evaluate the probability of entry and indicate the elements which make entry most likely or those that make it least likely. Identify the pathways in order of risk and compare their importance in practice.		Although it 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 except seeds. Entry = low to 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 low to 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.
Evaluate the probability of establishment, and indicate the elements which make establishment most likely or those that make it least likely. Specify which part of the PRA area presents the greatest risk of establishment.		Likelihood of establishment = High <u>Elements favouring establishment</u> Host plants, including wild hosts, are widely available Climatic conditions are suitable both outdoors and 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 Cultivars grown in protection are suspected to be resistant Greatest risk of establishment is in the Mediterranean part of the EPPO region but also

		under protected cultivation.
List the most important potential economic impacts, and estimate how likely they are to arise in the PRA area. Specify which part of the PRA area is economically most at risk.		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 important damage. In such situation major disruption of biological control programmes could be expected making organic farming difficult.
The risk assessor should give an overall conclusion on the pest risk assessment and an opinion as to whether the pest or pathway assessed is an appropriate candidate for stage 3 of the PRA: the selection of risk management options, and an estimation of the associated pest risk.		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.
This is the end of the pest risk assessment.		

Stage 3: Pest risk Management

3.1. Is the risk identified in the Pest Risk Assessment stage for all pest/pathway combination an acceptable risk?		**Pathway 1: Plants for planting of Solanaceae likelihood of entry is low to medium so risk management should be envisaged.** **Pathway 2: Fruits of Solanaceae 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**
Pathway 1		**Plants for planting of Solanaceae**
3.2. Is the pathway that is being considered a commodity of plants and plant products? **If yes, go to 3.11,** **If no, go to 3.3**	**Yes**	
3.3. Is the pathway that is being considered the natural spread of the pest (see answer to question 1.32)? **If yes, go to 3.4,** **If no, go to 3.9**		
3.4. Is the pest already entering the PRA area by natural spread or likely to enter in the immediate future? (see answer to question 1.33)		

3.5. Is natural spread the major pathway? **If yes, go to 3.29,** **If no, go to 3.6**		
3.6.Could entry by natural spread be reduced or eliminated by control measures applied in the area of origin? **If yes, possible measures: control measures in the area of origin, go to 3.7**		
3.7.Could the pest be effectively contained or eradicated after entry? (see answer to question 1.26, 1.34) **If yes, possible measures: internal containment and/or eradication campaign, Go to 3.8**		
3.8.Was the answer "yes" to either question 3.6 or question 3.7? **If yes, go to 3.38,** **If no, go to 3.44**		

3.9.Is the pathway that is being considered the entry with human travellers? **If yes, possible measures: inspection of human travellers, their luggage, publicity to enhance public awareness on pest risks, fines or incentives. Treatments may also be possible, Go to 3.29** **If no, go to 3.10**		
3.10. Is the pathway being considered contaminated machinery or means of transport? **If yes, possible measures: cleaning or disinfection of machinery/vehicles**		

3.11. If the pest is a plant, is it the commodity itself? **If yes, go to 3.29,** **If no ((the pest is not a plant or the pest is a plant but is not the commodity itself), go to 3.12**		
3.12. Are there any existing phytosanitary measures applied on the pathway that could prevent the introduction of the pest **if appropriate, list the measures and identify their efficacy against the pest of concern, Go to 3.13**	**Yes**	A phytosanitary certificate is required for all solanaceous plants for planting (except seeds), thus inspection before export is required. Import inspection is carried out on consignments of plants for planting. At least 27 out of 48 EPPO Member countries have restrictions on the import of Solanaceous plants. Requirements of the EU Plant Health Directive, 2000/29,: Plants of Solanum intended for planting, are prohibited from Third countries other than Mediterranean countries The directive also includes provisions regarding annual and biennial plants intended for planting, other than seeds, originating in countries other than European and Mediterranean countries: — have been grown in nurseries, — are free from plant debris, flowers and fruits, — have been inspected at appropriate times and prior to export, and — found free from symptoms of harmful bacteria, viruses and virus-like organisms, and — either found free from signs or symptoms of harmful nematodes, insects, **mites** and fungi, or have been subjected to appropriate treatment to eliminate such organisms. These measures include provisions for mites but the implementation of these general measures by exporting countries have been questioned several times at various EPPO meetings. Specific measures are more effective.

3.13. Can the pest be reliably detected by a visual inspection of a consignment at the time of export during transport/storage or at import? **If yes, possible measure: visual inspection, go to 3.14**	**Yes**	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**.** Inspection alone is not considered sufficient.
3.14. Can the pest be reliably detected by testing (e.g. for pest plant, seeds in a consignment)? **If yes, possible measure: specified testing, go to 3.15**	**NR**	Not relevant
3.15. Can the pest be reliably detected during post-entry quarantine? **If yes, possible measure: import under special licence/permit and post-entry quarantine, go to 3.16**	**Yes**	This option is not practical and should not be recommended.
3.16. Can the pest be effectively destroyed in the consignment by treatment (chemical, thermal, irradiation, physical)? **If yes, possible measure: specified treatment, go to 3.17**	**Yes**	Chemical treatments (combining treatments targeting adults and eggs) but their efficacy has to be verified by inspection.
3.17. Does the pest occur only on certain parts of the plant or plant products (e.g. bark, flowers), which can be removed without reducing the value of the consignment? (This question is not relevant for pest plants) **If yes, possible measure: removal of parts of plants from the consignment, go to 3.18**	**No**	
3.18. Can infestation of the consignment be reliably prevented by handling and packing methods? **If yes, possible measure: specific handling/packing methods, go to 3.19**	**No**	

3.19. Could consignments that may be infested be accepted without risk for certain end uses, limited distribution in the PRA area, or limited periods of entry, and can such limitations be applied in practice? **If yes, possible measure: import under special licence/permit and specified restrictions, go to 3.20**	**No**	It could be possible to allow import of plants for planting in northern parts of EPPO for outdoor use only but this would be difficult to apply in practice.
3.20. Can infestation of the commodity be reliably prevented by treatment of the crop? **If yes, possible measure: specified treatment and/or period of treatment, go to 3.21**	**Yes**	Treatment is possible, 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 (Ferragut, pers. com. 2007). Given the efficacy mentioned above this should be combined <ith other measures in the framework of the maintenance of a pest free place of production (see question 3.26).
3.21. Can infestation of the commodity be reliably prevented by growing resistant cultivars? (This question is not relevant for pest plants) **If yes, possible measure: consignment should be composed of specified cultivars, go to 3.22**	**No**	There is a potential for host plant resistance but no commercial cultivar can be recommended for the moment (Maluf *et al.*, 2001). This could be an option for the future.
3.22. Can infestation of the commodity be reliably prevented by growing the crop in specified conditions (e.g. protected conditions such as screened greenhouses, physical isolation, sterilized growing medium, exclusion of running water...)? **If yes, possible measure: specified growing conditions, go to 3.23**	**Yes**	No other host plants in the vicinity of the place of production. Hygienic measures to prevent the pest to enter the greenhouse. Such measures ensure a lower level of protection than the measures identified before, because it is difficult to ensure pest freedom of places of production.

3.23. Can infestation of the commodity be reliably prevented by harvesting only at certain times of the year, at specific crop ages or growth stages? **If yes, possible measure: specified age of plant, growth stage or time of year of harvest, go to 3.24**	**No**	Mites are present all year round (no diapause) in the Mediterranean climatic zone although in winter time population of mites is lower and contamination of the commodity is much less likely to happen.
3.24. Can infestation of the commodity be reliably prevented by production in a certification scheme (i.e. official scheme for the production of healthy plants for planting)? **If yes, possible measure: certification scheme, go to 3.25**	**No**	
3.25. Is the pest of very low capacity for natural spread? **If yes, possible measures: pest freedom of the crop, or pest-free place of production or pest-free area, Go to 3.28** **If no, go to 3.26**		
3.26. Is the pest of low to medium capacity for natural spread? **If yes, possible measures: pest-free place of production or pest free area, Go to 3.28** **If no, go to 3.27**	**yes**	During the EWG email contacts were made with other acarologists. Mr Margolies (Kansas State University, US who has done a substantial amount of work on aerial dispersal of spider mites) indicated that mites could spread slowly via winds, but their effective range is probably limited to a few kilometres per event. He gave an indication of a range “about five kilometres”. Pest Free Area Pest Free Place of Production: Plants for planting coming from Mediterranean climate region and other countries where the pest is present: 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 (see question 3.20) • Two inspections of the consignment prior to export

3.27. The pest is of medium to high capacity for natural spread **Possible measure: pest-free area, go to 3.28**		
3.28. Can pest freedom of the crop, place of production or an area be reliably guaranteed? **If no, possible measure identified in questions 3.25-3.27 would not be suitable, go to 3.29**	**Yes**	But it should be noted that hygienic measures should be applied to prevent mites entering a production site if the surrounding area is infested (see 3.26).
3.29. Are there effective measures that could be taken in the importing country (surveillance, eradication) to prevent establishment and/or economic or other impacts? **If yes, possible measures: internal surveillance and/or eradication campaign, go to 3.30**	**No**	
3.30. Have any measures been identified during the present analysis that will reduce the risk of introduction of the pest? List them. **If yes, go to 3.31** **If no, go to 3.38**	**Yes**	Visual inspection (to be combined) Treatment of the consignment Treatment of the crop Pest free area Place of production + immediate vicinity free from host plants
3.31. Does each of the individual measures identified reduce the risk to an acceptable level? **If yes, go to 3.34** **If no, go to 3.32**	**No**	
3.32. For those measures that do not reduce the risk to an acceptable level, can two or more measures be combined to reduce the risk to an acceptable level? **If yes, go to 3.34** **If no, go to 3.33**	**Yes**	Treatment of the consignment + Visual inspection

3.33. If the only measures available reduce the risk but not down to an acceptable level, such measures may still be applied, as they may at least delay the introduction or spread of the pest. In this case, a combination of phytosanitary measures at or before export and internal measures (see question 3.29) should be considered. **Go to 3.34**		
3.34. Estimate to what extent the measures (or combination of measures) being considered interfere with trade. **Go to 3.35**		There are already prophylactic treatments used at pest free places of production of tomato in the Mediterranean area where the pest occurs outdoors (Palevsky, pers com. 2007). Requiring place of production freedom is common measures for plants for planting.
3.35. Estimate to what extent the measures (or combination of measures) being considered are cost-effective, or have undesirable social or environmental consequences. **Go to 3.36**		Small fraction of production cost for plants for planting which are valuable. Care should be taken to use plant protection products that are not persistent.
3.36. Have measures (or combination of measures) been identified that reduce the risk for this pathway, and do not unduly interfere with international trade, are cost-effective and have no undesirable social or environmental consequences? **If yes, For pathway-initiated analysis, go to 3.39** **For pest-initiated analysis, go to 3.38** **If no, go to 3.37**	**Yes**	Visual inspection + Treatment of the consignment Pest-Free Area Pest-Free Place of Production

3.37. Envisage prohibiting the pathway **For pathway-initiated analysis, go to 3.43 (or 3.39),** **For pest-initiated analysis go to 3.38**	**No**	
3.38. Have all major pathways been analyzed (for a pest-initiated analysis)? **If yes, go to 3.41,** **If no, Go to 3.1 to analyze the next major pathway**	**Yes**	
3.39. Have all the pests been analyzed (for a pathway-initiated analysis)? **If yes, go to 3.40,** **If no, go to 3.1 (to analyze next pest)**		
3.40. For a pathway-initiated analysis, compare the measures appropriate for all the pests identified for the pathway that would qualify as quarantine pests, and select only those that provide phytosanitary security against all the pests. **Go to 3.41**		
3.41. Consider the relative importance of the pathways identified in the conclusion to the entry section of the pest risk assessment **Go to 3.42**		

3.42. All the measures identified as being appropriate for each pathway or for the commodity can be considered for inclusion in phytosanitary regulations in order to offer a choice of different measures to trading partners. **Go to 3.43**		
3.43. In addition to the measure(s) selected to be applied by the exporting country, a phytosanitary certificate (PC) may be required for certain commodities. The PC is an attestation by the exporting country that the requirements of the importing country have been fulfilled. In certain circumstances, an additional declaration on the PC may be needed (see EPPO Standard PM 1/1(2): Use of phytosanitary certificates) **Go to 3.44**		
3.44. If there are no measures that reduce the risk for a pathway, or if the only effective measures unduly interfere with international trade (e.g. prohibition), are not cost-effective or have undesirable social or environmental consequences, the conclusion of the pest risk management stage may be that introduction cannot be prevented. In the case of pest with a high natural spread capacity, regional communication and collaboration is important.		
Conclusion of Pest Risk Management. **Summarize the conclusions of the Pest Risk Management stage. List all potential management options and indicate their effectiveness. Uncertainties should be identified.**		**See PRA report**

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Appendix 1

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