Pest Risk Analysis For *Tomato infectious chlorosis virus*

1. Name of Pest: *Tomato infectious chlorosis virus* (TICV), the cause of an infectious chlorosis disease of tomato.

2 (a) Does it occur in the UK/EU/EPPO region or arrive regularly as a natural migrant ? In the EU/EPPO region, TICV has been found in tomato in the Liguria, Lazio, Campania and Sardinia regions of Italy (Wisler *et al*., 1998; Vaira *et al*., 2002) and in the Castellón, Murcia and Alicante provinces of Spain (Font *et al*, 2002, 2003, 2004) and in many regions of Greece (Dovas *et al*., 2002). TICV may also be present in the Czech Republic but this has not been confirmed by the Czech authorities (see 6 below). Details on the distribution of the pathogen on other hosts in the UK/EU/EPPO region are given under 5. below.

(b) Is there any other reason to suspect that the pest is already established in the UK/EU/EPPO region ? See above

3. EU Directive status ? No status

4. EPPO status ? Present on Alert List since 1997 (Anon., 1997)

5. What are its host plants ?

(a) Highlight the crop plants grown economically, including those of environmental or amenity value, in the UK (and EU/EPPO region) (include figures for potential yield/quality losses): The crops *Lycopersicon esculentum* (tomato), *Lactuca sativa* (lettuce) *Physalis ixocarpa* (tomatillo) and *Cynara scolymus* (artichoke): the ornamentals *Petunia hybrida* (petunia), *Ranunculus* sp. (ranunculus), and *Callistephus chinensis* (China aster); and the weeds *Picris echioides* (bristly oxtongue), *Nicotiana glauca* (tree tobacco) and *Cynara cardunculus* (wild artichoke) are natural hosts in California (Wisler *et al*., 1998). *Zinnia elegans* (zinnia) is a natural host in Taiwan, but not tomato (Tsai *et al*., 2004). Tomato is a host in Spain (Font *et al*., 2002), Italy (Wisler *et al*., 1998; Vaira *et al*., 2002) and Greece (Dovas *et al*., 2002) and artichoke is a host in Italy (Caciaglo, 2001). *Chenopodium album* (fat-hen) and *Chenopodium murale* (sow-bane) are weed hosts in Spain (Font *et al*., 2004). *Solanum tuberosum* (potato) is one of a number of experimental hosts (Wisler *et al*., 1998).

When TICV was first found in the Irvine area of Orange County, California, in 1993, symptoms of the disease affected virtually 100% of tomato plants in every field. The disease was associated with a high incidence of *T. vaporariorum* (Duffus *et al*., 1996). In one season in Orange County, growers suffered US$2 million in losses (Wisler *et al*., 1998). However, TICV is now described as having the potential to cause severe losses in tomato, but generally only causing minor losses (Anon., 2003b).

In the Liguria region in northern Italy, TICV was found in back garden tomato crops at the end of the growing season in 1995 and 1997, but damage was not very high. Incidence was associated with high populations of *T. vaporariorum* (Anon. 2000, personal communication and unconfirmed). Although TICV has also been reported in artichokes in the same area (Caciagli, 2001), the pathogen is not regarded as a serious problem. Tomato is not grown commercially on a year round basis in Liguria, there is a host-free period in the winter and populations of *T. vaporariorum* are slow to build up in the summer after being reduced significantly in open fields during the winter. These factors are believed to have diminished the impact TICV has on the tomato industry in this locality (Anon. 2000, personal communication and unconfirmed). However, TICV has now been found in tomato in the Lazio and Campania regions of Central Italy and in Sardinia. Yellowing and reddening leaf symptoms have been reported to be severe and widespread. Plants were said to be less vigorous with fruit that sometimes showed delayed ripening. TICV was described as a severe threat to tomato crops in Europe (Vaira *et al*., 2002).

Effects of TICV on production is lacking from other countries, although 80-100% infection incidence was reported in some tomato crops in Greece (Dovas *et al*., 2002).

There is no information on the effects of TICV on artichoke and lettuce crops or ornamental species known to be natural hosts.

Tomato is grown extensively in the EPPO region. Artichoke and lettuce are other commonly-grown, high value crops at risk. Production estimates for Europe for 2003 were 20,744,016Mt of tomato, 3,123,866Mt of lettuce and 728,566Mt of artichoke (FAO, 2004). The production of tomatoes in the UK was valued at £84,326,000 in 2000 and £78,740,000 in 2001 (Anon., 2003a). Wild artichoke (*C. cardunculus*), which is a weed host of TICV in California, is grown commercially in southern Europe.

(b) Are any of the host plants of Forestry importance ? No

6. What is its present geographical distribution ?

Asia: Japan (Hartono *et al*, 2003); Taiwan (Tsai *et al*., 2004)
Africa: No record
North America: Possibly Mexico (based on detection of TICV in tomato total nucleic acid samples sent to the USA for analysis; W. W. Wintermantel, USA, 2002, personal communication); USA (California, North Carolina) (Duffus *et al*., 1996; Wisler *et al*., 1998).
Central America and the Caribbean: No record
South America: No record
Oceania: No record
EU: Possibly Czech Republic (based on detection of TICV in tomato total nucleic acid samples sent to the USA for analysis; W. Wintermantel, USA,

2002, personal communication); Greece (Dovas *et al*., 2002); Italy (Wisler *et al*., 1998a; Vaira *et al*., 2002); Spain (Font *et al*., 2002, 2003, 2004)

EPPO region: As EU

7. Does it appear capable of becoming established in the UK/EU/EPPO ?

(a) outdoors. Yes. *Trialeurodes vaporariorum,* the whitefly that transmits TICV, occurs on field crops in the EU/EPPO region in the summer. TICV is already established in tomato in Italy, Spain and Greece and may spread to other areas if precautions are not taken. The tomato crop is grown outdoors in many Mediterranean countries within the EU/EPPO region. Tomato is not grown commercially outdoors in northern Europe, but home garden plants may be at risk. TICV may have established in *Chenopodium* weeds in Spain (Font *et al*., 2004) and it could also establish on other outdoor crop hosts, such as artichoke.

(b) on protected crops. Yes. TICV has been reported in glasshouse tomato crops in Greece (Dovas *et al*., 2003) and could become established on other protected and semi-protected tomato crops in the EU/EPPO region. *Trialeurodes vaporariorum* is widespread and common in glasshouses. TICV may also establish on other crop hosts grown in protected environments.

8. What is its potential likely to be as a pest or as a vector of viruses in the UK/EU/EPPO ? TICV has the potential to cause significant losses in tomato and other naturally susceptible crops if it becomes established. Control would depend on the efficacy of treatments and strategies to limit populations of *T. vaporariorum*, which transmits the virus from plant to plant. *Trialeurodes vaporariorum* is present in glasshouses in many countries in the EU/EPPO region, but has not been reported as causing significant problems, at least in the UK, in recent years. However, the situation could change if control methods fail. TICV may also become a serious problem in field grown or semi-protected crops in southern EU/EPPO regions.

9. What are the prospects for continued exclusion ? TICV is already established in Greece, Italy and Spain and may spread from there if precautions are not taken. Its occurrence in the Czech Republic requires confirmation. Exclusion of TICV from countries where it does not occur is dependent on the importation of host plants free of the virus. If it gains entry, TICV could become established on protected tomato and other host crops in the EU/EPPO region as *T. vaporariorum* is widespread and common in glasshouses. *Trialeurodes vaporariorum* also occurs on outdoor crops in Europe in the summer and would be expected to increase the incidence of TICV in field crops if sufficiently numerous. Whitefly vectors would not be expected to spread the virus quickly to new areas under natural conditions. However, viruliferous whiteflies could hitchhike on plants and plant produce moving in international trade.

10. What are the prospects for eradication ? Tomatoes are grown commercially in protected environments in northern areas of the EU/EPPO region and in semi-protected environments or in the field in southern areas. Eradication may be possible if TICV is recognised in the glasshouse of introduction before plant and whitefly movements have the chance to spread the virus to other locations. It would be much more difficult to control an outbreak in the field, especially as some common European weeds, such as *C. album* and *C. murale*, have the capacity to act as reservoirs of infection (Font *et al*., 2004).

11. How would eradication be achieved ? Eradication in glasshouses growing tomato would necessitate the destruction of all plants with disease symptoms and also all infestations of *T. vaporariorum.* Any other susceptible species in the same glasshouses would also have to be destroyed. Susceptible plants in adjacent glasshouses would have to be closely observed for symptoms and *T. vaporariorum* strictly controlled. Eradication of TICV in field crops would entail the destruction of all plants in a given area and the elimination of whiteflies by spraying with insecticides. Any weeds that could act as reservoirs of infection would also have to be controlled.

12. Conclusion. TICV has caused a significant disease of tomato in California in the USA and is reported as having a high incidence in some tomato crops in southern Europe. TICV has also been detected on artichoke in California and Italy and lettuce in California, although problems have not been reported as serious. Incidence may be related to the activity of local populations of the vector *T. vaporariorum.* Although crop yield and quality losses have not been determined experimentally for TICV, its recent occurrence in some countries in the EU/EPPO region is viewed as a threat to tomato cultivation and possibly other crop species in Europe. It is recommended that efforts should be made to prevent its spread by controlling the movement of tomato seedlings from known affected areas. It is also recommended that isolated outbreaks of TICV should be eradicated by destruction of infected plants and whitefly vectors. Tomato lines introduced from the USA for breeding purposes should be indexed for TICV. Consideration should be given to declaring TICV an A2 Quarantine Pest and an EU IIAII harmful organism.

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