

Emerging viroid threats to UK tomato production



Figure 1. PSTVd symptoms from the UK outbreak site showing severe yellowing and leaf curling

Background

Over the last few years three viroids have been identified in the UK which pose a significant threat to tomato production. *Potato spindle tuber viroid* (PSTVd) was confirmed in both a tomato crop and imported solanaceous ornamentals, *Tomato chlorotic dwarf viroid* (TCDVd) was recorded in imported petunia plants and *Columnnea latent viroid* (CLVd) has been identified in five tomato crops. All of these were considered to pose a significant risk to UK tomato production and statutory action was taken to eradicate them.

Four other viroids have been reported to naturally infect tomato plants, these are *Citrus exocortis viroid* (CEVd), *Tomato apical stunt viroid* (TASVd), *Tomato planta macho viroid* (TPMVd) and *Mexican papita viroid* (MPVd). So far none of these viroids have been reported in the UK on any host.

Viroids

Viroids are the smallest known pathogen of plants, consisting of a single strand RNA molecule and differ from viruses in that they lack a protein shell. They are classified into two families, the *Avsunviroidae* and the *Pospiviroidae*. Within the family *Pospiviroidae* the genera *Pospiviroid* contains the seven species which have been isolated from naturally infected tomato plants, PSTVd, TCDVd, CLVd, CEVd, TASVd, TPMVd and MPVd.

There are no chemical or biological controls available to control viroids within a plant. Therefore exclusion of infected seed or planting material and destruction of infected plants coupled with hygiene measures to prevent infection of subsequent crops are the only means of control.

Tomato Viroids in the UK

Potato spindle tuber viroid

PSTVd is probably the most well known of the viroids affecting tomatoes and although it has a worldwide distribution, it is considered to be absent from the EU. However recently there have been outbreaks of PSTVd in tomato crops in the UK, Belgium, France, Germany and the Netherlands, all of which have been eradicated.

The principal hosts of PSTVd are potatoes, tomatoes and solanaceous ornamentals. However, it is generally symptomless in ornamentals. Seed transmitted has been demonstrated and it can be spread within a crop by mechanical transmission e.g. when working on the crop or during grafting. PSTVd was found under controlled conditions in a potato germplasm collection in the UK in 1973 but the first reported outbreak in a commercial crop was in tomatoes in 2003. Approximately 80 plants were showing virus like symptoms, including yellowing and leaf curling. In addition the whole plants were stunted and stems were bunching at the crown (Fig. 1 and 2). Spread of PSTVd within the crop was relatively slow. Action was taken to eradicate this outbreak and there was no evidence of spread to other tomato crops or surrounding potato crops. PSTVd did not occur in the following season and the outbreak was officially declared eradicated late in 2004.

Since this outbreak there have been a number of findings of PSTVd in solanaceous ornamentals in the UK (*Solanum jasminoides*, *Solanum ratonnetii* and *Brugmansia* sp). All the infected material was symptomless and had recently been imported from the EU.

Tomato chlorotic dwarf viroid

TCDVd is known to be capable of infecting tomatoes but it has not been reported in tomatoes in the UK. It causes similar symptoms to PSTVd in tomato crops (Fig. 3) and has a similar host range including potatoes and solanaceous ornamentals. Transmission of TCDVd is by mechanical means; seed transmission has been demonstrated and soaking seed in sodium hypochlorite does not eliminate the viroid. Infection of a tomato crop with TCDVd may result in the crop producing very small fruit which could be totally unmarketable.

TCDVd has been recorded in tomato crops in the Netherlands and France. TCDVd came to the attention of the Plant Health authorities in the UK following its interception on petunias. Like PSTVd, TCDVd causes few symptoms in ornamental hosts. Some puckering and distortion of the leaves and yellowing of the veins was observed in infected petunia plants, but these symptoms seemed to be temporary.



Figure 2. PSTVd symptoms from the UK outbreak site showing bunching of the stems ('bunchy top') and yellowing in the crown



Figure 3. TCDVd in a growing tomato crop (Courtesy of Dr. Rudra Singh, Agriculture Canada, New Brunswick, Canada)

Columnnea latent viroid

Until recently CLVd was thought to only infect the ornamental species *Brunfelsia erythrophae* (Jamaican raintree), *Columnnea undulate* and *Nematanthus wettsteini* (goldfish plant). However retrospective analyses of samples from viroid outbreaks in the Netherlands and Belgium have shown that infection can occur in tomatoes. The outbreaks in the Netherlands and Belgium were all subsequently eradicated. However in 2007, CLVd was detected in four tomato crops in the UK and a number of tomato crops in France. There was also one further UK outbreak in 2009.

Like PSTVd and TCDVd, CLVd causes few symptoms in ornamental hosts. However CLVd causes serious problems in tomato. Symptoms can be similar to those caused by PSTVd, with stunting, leaf distortion and chlorosis. In the UK outbreaks, leaf reddening ('bronzing') and necrosis were also prominent symptoms (Fig. 4 and 5), fruit quality was unaffected but yield was reduced. Unlike PSTVd spread within the crop was rapid, at one of the outbreak sites infection which appeared to start from just three plants had spread to approximately 60% of the crop by the end of the growing season. Seed transmission of CLVd has not been proven, however, there is strong circumstantial evidence that all the 2007 outbreaks were caused by infected seed as all outbreaks (including those in France) were in the same variety, the seed was the only common factor linking the outbreaks. All four outbreaks for 2007 were successfully eradicated and monitoring of the 2009 outbreak site continues to ensure there has been no carryover of infection to subsequent crops.



Figure 4. CLVd symptoms from the UK outbreak site showing bronzing of the leaves



Figure 5. CLVd symptoms from the UK outbreak site showing thin stems of infected plant (left)

Other viroid threats to tomato production

Four other viroids which have not been reported in the UK can also naturally infect tomatoes, *Citrus exocortis viroids* (CEVd), *Tomato apical stunt viroid* (TASVd), *Tomato planta macho viroid* (TPMVd) and *Mexican papita viroid* (MPVd).

Citrus exocortis viroid

CEVd has a worldwide distribution but mainly in citrus. Its distribution within Europe is limited. There are few reports of natural infection of tomatoes but in 1991 it was established that tomato bunchy top diseases in India were caused by a strain of CEVd and outbreaks have also been confirmed in tomatoes in the Netherlands. CEVd is known to be mechanically transmitted but it is not clear whether it can be transmitted by tomato seeds.

Tomato apical stunt viroid

TASVd was reported in 1999 and 2000 as a new and serious disease of tomatoes in Israel. Plants showed severe symptoms including stunting, leaf deformation, yellowing and brittleness. The fruit was considerably reduced in size with a pale red discolouration. The disease spread rapidly along the rows, resulting in nearly 100% infection in most cases and heavy yield losses. Mechanical and seed transmission of TASVd has been demonstrated. Also, it has been confirmed that bumblebees can transmit the viroid from infected plants to healthy plants during pollination.

Tomato planta macho viroid

TPMVd is only present in Mexico. It causes severe losses in commercial crops. Infected plants will produce only marble-size fruit which is completely unmarketable. However, seed transmission has not been demonstrated, TPMVd is mechanically and aphid transmitted.

Mexican papita viroid

MPVd has recently been identified in a tomato crop in Canada. This is the first time MPVd has been found in tomatoes. Plants exhibited general stunting and chlorotic/purple leaves. Diseased plants either produced no fruit or reduced size fruit. No information on the means of transmission is available.

Conclusions

New viroids are posing an increasing threat to tomato production in the UK and can spread quickly within a crop. Growers are advised to check plants regularly for anything unusual. Plants which are exhibiting symptoms such as chlorosis, bronzing, leaf distortion or reduced growth should be notified to the Plant Health and Seeds Inspectorate. Even prior to laboratory diagnosis of any sample taken, if a grower suspects a problem, it would be advisable for them to implement hygiene measures. For example, requiring crop workers to wear disposable gloves which are changed at the end of rows and always have the same workers working in the affected area/glasshouse.

Advisory Information

The main advice to growers is to be vigilant for any unusually symptoms in the crop and implement good hygiene measures as a matter of course.

Suspected outbreaks of a viroid in a tomato crop or any other non-native plant pest should be reported to your local Fera Plant Health and Seeds Inspector, or

Tel: 01904 465625

Email: planthealth.info@fera.gsi.gov.uk

Web: www.defra.gov.uk/fera/plants/plantHealth

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