



Tomato brown rugose fruit virus



Figure 1. Brown spotting caused by infection with tomato brown rugose fruit virus (Source EPPO/Camille Picard)

Background

Tomato brown rugose fruit virus (ToBRFV) is a member of the genus *Tobamovirus*. However, unlike other tomato infecting members of the genus, such as tobacco mosaic virus (TMV) and tomato mosaic virus (ToMV), ToBRFV can overcome the *Tm-2²* resistance gene. This means that tomato varieties which are resistant to TMV and ToMV will be susceptible to infection with ToBRFV. ToBRFV was first described infecting tomato crops in Israel in 2014, but has subsequently spread to other tomato growing regions around the world.

As with other tobamoviruses, ToBRFV is readily spread via contact transmission and is also seed transmissible. The virus has also been shown to be transmitted by bumblebees during pollination. The virus is environmentally stable and also relatively heat tolerant making control of the pathogen challenging.

Geographical Distribution

ToBRFV was first observed in Israel in 2014, and in Jordan in the following year. Since then (up to March 2020), the virus has been officially reported from China, France, Greece, Italy, Mexico, the Netherlands, Spain, Turkey and the UK, however the distribution is rapidly changing, the virus is likely to be more widespread than currently reported, and for full records it is recommended to check the EPPO Global Database which is updated regularly (<https://gd.eppo.int/>). There have also been outbreaks in Germany and the USA, but these have been eradicated. An outbreak was confirmed in a tomato glasshouse in south-east England in the summer of 2019, and phytosanitary measures were taken to eradicate the virus.

Host Plants

The major natural hosts are tomato and pepper. Whilst there has been a report of infection in aubergine, this appears to be related to detection from a seed lot, and not from an infected plant. Whilst weeds are recognised as being potential reservoirs little is known about the susceptibility of non-cultivated (weed) hosts. It is likely that other solanaceous species (tomato family) could be hosts for the virus.

Description

The virus is named after the brown, wrinkled (rugose) patches which can develop on the fruit of infected plants. However, this distinct symptom is somewhat uncharacteristic of infection with the virus. Fruit generally suffers from discoloration (e.g. chlorotic marbling and dark spots), uneven ripening, deformation, reduced size, and necrotic patches or spotting.

Foliar (leaf) symptoms include mosaic patterning which can range in severity from obvious to subtle. Leaf deformation may also occur such as puckering and narrowing, blistering, or reduction in leaflet size. Plants may also exhibit wilted leaves. Necrosis may develop on pedicels (stems), calyces, petioles and flowers.



Figure 2: Leaf deformation (Source Defra / Neil Giltrap)



Figure 3: Tomato fruit discoloration (Source Defra / Neil Giltrap)



Figure 4: Tomato fruit discoloration (Source Defra / Neil Giltrap)

Biology

ToBRFV is transmissible through both sap transfer and contact.

The virus is seed transmissible, though it is thought to be limited to the seed coat and does not infect the embryo. However, the virus can survive on the seed coat for several years. Seed to seedling transmission is thought to be inefficient, and has not yet been experimentally demonstrated, though this route of transmission is strongly suspected to occur.

In plants, ToBRFV will enter through small wounds, enter a cell and reproduce using the cells own replication mechanisms. The virus then moves from cell to cell or moves longer distances within the plant via the phloem.

Infection with the virus will be systemic within the plant and all parts of an infected plant will be a source of contamination. For example, handling fruit from infected plants will be a source of contamination that could then be passed on to other plants.

Most commercial tomato varieties carry resistance genes to defend against infection with tobamoviruses such as tobacco mosaic virus and tomato mosaic virus (TMV and ToMV), known as Tm-2² genes. However, ToBRFV can overcome this genetic resistance.

Fortunately, pepper plants with the tobamovirus resistance genes L¹, L³ and L⁴ appear to retain resistance to ToBRFV.

Tobamoviruses are recognised to have robust virions (virus particles) which can withstand both raised temperatures and extended periods outside of a host cell and remain infectious. On both skin and disposable gloves exposed to contamination with ToBRFV, the virus remained active for over two hours. Handwashing has been shown to be of limited efficacy in removing viral contamination. The virus was also demonstrated to remain active on multiple surfaces (concrete, steel, aluminium, glass, hard plastic and polythene) for between one and three months, and in some cases up to six months.

Dispersal and Detection

Long distance dispersal of the virus is likely through movement of contaminated seed, and more localised movement may be through infected fruit in trade or the trade in propagation plants (plants for planting) coming from nurseries with established sources of infection.

The virus can be spread over short distances through plant-to-plant contact or through human mediated spread (plant handling, grafting) on contaminated hands, gloves or clothing. Bumblebees have also been shown to be a potential dispersal route within a glasshouse during pollination. The virus will also be transferred on tools and equipment coming into contact with infected plants and fruit such as cutting knives, plastic trays and vehicles. Other items which can be inadvertently contaminated will also be potential sources for onward spread of the virus including mobile phones, watches and jewellery.

Detection of the virus through symptom recognition is not considered to be a reliable method for identifying infections. The symptoms may appear to be similar to other virus infections or physiological conditions such as nutrient deficiency. Therefore laboratory diagnosis is required to confirm the presence of the virus.

Economic Impact

ToBRFV can infect up to 100% of a crop (reported in Jordan), and yield losses of between 25 and 70% have been reported, largely due to the fruit being unmarketable, and the loss

of production period as plants reduce in vigour and die prematurely. Additional costs can be incurred through removal of infected crops and cleaning of the glasshouse.

However, it is possible for plants to show no obvious symptoms and yet still be infected, and the susceptibility of the crop is dependent on the variety, cultural practices and the climate, with glasshouse crops expected to be more susceptible than outdoor grown crops, as there is more handling and spread via mechanical transmission. Tomatoes are more likely to be susceptible than peppers, with pepper varieties with the L¹, L³ and L⁴ genes appearing to be resistant.

Advisory Information

The best means of prevention is to use virus free planting material. In 2019, statutory measures were agreed by the EU and published on 30th September in 2019 to reduce the risk of ToBFRV being introduced into and spread within the EU (2019/1615) on plants for planting including seeds. These measures also apply to the UK.

There are no treatments available, and the only means of removing the virus from a crop is by destroying the plants and following good hygiene practice, details of which have been published by the AHDB:

<https://ahdb.org.uk/knowledge-library/tomato-brown-rugose-fruit-virus>

Suspected outbreaks of tomato brown rugose fruit virus or any other non-native plant pest should be reported to the relevant authority:

For **England and Wales**, contact your local **APHA Plant Health and Seeds Inspector** or the **PHSI Headquarters**, York. Tel: 01904 405138

Email: planthealth.info@apha.gov.uk

For **Scotland**, contact the **Scottish Government's Horticulture and Marketing Unit**:

Email: hort.marketing@gov.scot

For **Northern Ireland**, contact the **DAERA Plant Health Inspection Branch**:

Tel: 0300 200 7847 Email: planthealth@daera-ni.gov.uk

For additional information on UK Plant Health please see:

<https://secure.fera.defra.gov.uk/phiw/riskRegister/>

<https://planthealthportal.defra.gov.uk/>

<https://www.gov.uk/plant-health-controls>

<http://www.gov.scot/Topics/farmingrural/Agriculture/plant/PlantHealth/PlantDiseases>

<https://www.daera-ni.gov.uk>

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