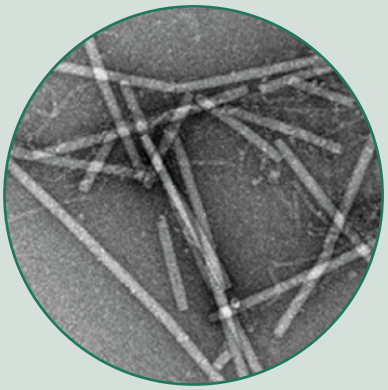


TOMATO BROWN RUGOSE FRUIT VIRUS



KEY CHARACTERISTICS

» **Appearance: non-enveloped virus with the form of a helix**

» **Spread: mainly in North America, Europe and the Middle East (all areas where tomato production occurs)**

» **Quarantine organism**

» **Crops:**







Tomato brown rugose fruit virus (ToBRFV) is a mechanically transmitted virus, first described in Jordan in 2014. ToBRFV causes deformed and bulging leaves, yellow spots on fruits and yellowed leaf veins (mosaic discoloration) in tomato plants with non-marketable fruits and loss of yield as a result. At the end of 2019, the virus was given the status of quarantine organism.

SPREAD

ToBRFV belongs to the Tobamo-viruses, similar to the Tobacco Mosaic Virus (TMV) and Tomato Mosaic Virus (ToMV). **ToBRFV** is extremely stable and highly virulent. It can be transmitted through contact (= mechanically) and spreads during crop handling via hands, clothes, tools or plant-to-plant contact. Additionally, also contaminated seeds, water, insects, host plants, tobacco, and containers can be the cause of an outbreak.
Until recently, no commercial tomato varieties were tolerant to **ToBRFV**, but breakthroughs came in 2021, making the first resistant varieties available for the market.

SYMPTOMS AND LIFE CYCLE







The symptoms of **ToBRFV** are very similar to other Tobamoviruses (such as ToMV), but fruits might be affected more severely.

» When a tomato plant is infected with **ToBRFV**, the leaves can be rolled or deformed with often a mosaic pattern present on them (1).
» The stem can show necrosis (2).
» Plants infected early will be stunted with poorly formed fruit. Fruits from plants infected in a later stage, may show discoloration (3).
» One of the typical symptoms of the Tomato Brown Rugose Fruit virus are fruits that show a browning calyx, the tomatoes are often undersized with a rough surface. "Rugose" also means wrinkled. Similar to tomato fruits, bell peppers can also discolour after infection with **ToBRFV**.

*Reference ToBRFV picture: Luria N, Smith E, Reingold V, Bekelman I, Lapidot M, et al. (2017) A New Israeli Tobamovirus Isolate Infects Tomato Plants Harboring Tm-22 Resistance Genes. PLOS ONE 12(1): e0170429. https://doi.org/10.1371/journal.pone.0170429

ECONOMICAL IMPACT OF THE PATHOGEN

ToBRFV is a highly virulent virus and can cause serious damage. The highest impact is expected in intensive glasshouse production areas. The virus can infect up to 100% of the plants in a crop and cause 30–70% loss of tomato yield on plants. Infection can also significantly reduce plant vigour or lead to premature death of the plant, thereby reducing the length of the production period during which tomato fruits are harvested.

HUWA-SAN TR-50 AND ROAM ECO CLEAN EFFICACY TESTS

The efficacy of **Huwa-San TR-50** and **Roam Eco Clean** against **ToBRFV** was tested at an independent certified institute by adding our product to dirty drain samples taken at a greenhouse during a **ToBRFV** outbreak.

Overview of Efficacy		
Concentration	**200 ppm** Huwa-San TR-50	Water samples of a dirty drain containing ToBRFV were exposed to 200 ppm Huwa-San TR-50 for 12 h. Afterwards, a qPCR was performed.
Contact time	**12 h**	
Test result	Reduced presence of ToBRFV	
Concentration	**1%** Huwa-San TR-50	Water samples of a dirty drain containing ToBRFV were exposed to 1% Huwa-San TR-50 for 14 h. Afterwards a near-full genome PCR was performed.
Contact time	**14 h**	
Test result	ToBRFV not detected	
Concentration	**6%** Huwa-San TR-50	6% dilution of Huwa-San TR-50 was sprayed on a glassplate. After a contact time of 5 minutes, the glassplate was sampled with a cotton swab which was subsequently rubbed over the leaves of a plant. Afterwards, the lesions on the leaves were counted.*
Contact time	**5 min**	
Test result	Reduction from > 250 to 2.2 lesions per leaf	
Concentration	**2%** Roam Eco Clean	Water samples of a dirty drain containing ToBRFV were exposed to 2% Roam Eco Clean for 30 min. Afterwards, a near-full genome PCR was performed.
Contact time	**30 min**	
Test result	ToBRFV not detected	

*A sample with ToBRFV that was not treated served as positive control, whereas a sample without ToBRFV served as negative control. The plants swabbed with the negative control, showed no symptoms of infection, whilst for the positive control all plants were infected with ToBRFV.

MEASURES TO PREVENT TOBRFV INFECTION

- **Prevent ToBRFV from entering your greenhouse, limit access to people who don't need to be in the greenhouse!**
- **Knowledge is key, get trained by our hygiene experts and stay on top of your game on product knowledge.**
- **Disinfect the materials used in the greenhouse and perform a complete and thorough cleaning and disinfection during crop rotation.**
- **Do regular inspections and check for ToBRFV symptoms.**
- **Think about Personal Hygiene and wear clean clothing when entering or use a disposable overall.**
- **Disinfect the irrigation system continuously with 40 - 60 ppm Huwa-San TR-50 to maintain a clean and pathogen free watering system.**
- **Use H_2O_2 test strips to assure a residual concentration of Huwa-San can be measured at the end of the water pipelines.**
- **During crop rotation, disinfect with 1% Huwa-San TR-50 and respect the contact time.**

ROAM TECHNOLOGY

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