Novel Approaches for the Management of Tomato Brown Rugose Fruit Virus (ToBRFV)

LEAD RESEARCHER

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Researchers are working to stop Tomato Brown Rugose Fruit Virus (ToBRFV) from threatening Canadian greenhouse tomatoes and peppers. This research activity has been studying the infection process and working to develop novel genetic resistance to ToBRFV. Promising results have discovered ToBRFV resistance genes and new biocontrol measures to manage ToBRFV.

Researchers have been able to develop novel genetic resistance for ToBRFV in an elite tomato cultivar. This breakthrough was made through generation and screening of a tomato mutant population. The research team is now working to identify the gene responsible for this novel resistance. This will allow for growers to control ToBRFV through genetic resistance. Genetic resistance is environmentally friendly, target-specific and provides reliable protection without additional labour or material costs during the growing season.

The research team has been working to better understand how ToBRFV overcomes Tm-22 broad-spectrum resistance. It was discovered that while ToBRFV can dodge Tm-22 extreme resistance, tomato plants with Tm-22 gene still show partial resistance to ToBRFV. This weakened resistance can be boosted by increasing Tm-22 expression levels. The Tm-22 gene-encoded protein interacts with the ToBRFV-coded movement protein (MP) to trigger resistance pathways. This shows the possibility to restore Tm-22-mediated immunity through gene expression increases.

Weakened ToBRFV strains that can be used for cross-protection against ToBRFV have been developed by the research team. These strains could potentially allow growers to manage ToBRFV using a biocontrol approach.

A tomato plan infected with Tomato Brown Rugose Fruit Virus (ToBRFV). Photo: Aiming Wang

It was also discovered that several seed-borne viruses, particularly ToBRFV and pepino mosaic virus (PepMV), and to a lesser extent southern tomato virus (STV), are prevalent in greenhouse tomatoes in Canada. A mixed infection of ToBRFV and PepMV induces more severe symptoms, often causing crop termination. New research is needed though to develop a protocol to detect tomato seed-borne viruses and understand why the mixed infection of PepMV and ToBRFV causes more severe symptoms.

Over the next year, the research team is planning to focus on generation population mapping and phenotyping. They will complete screening for ToBRFV resistance from the tomato (Roma) mutant population. Functional characterization of host proteins interacting with ToBRFV infection proteins will be started. The researchers plan to characterize long non-coding RNAs associated with ToBRFV pathogenesis and symptom development. They will continue monitoring ToBRFV diversity in Canada by sequencing and analysis of samples collected in major production regions across Canada. The research team plans to start a study to understand why ToBRFV and PepMV mixed-infections cause more severe symptoms.

KEY TAKEAWAYS:

- Researchers have been able to develop novel genetic resistance for ToBRFV in an elite tomato cultivar and are now working to identify the gene responsible for this novel resistance.
- While ToBRFV can dodge Tm-22 extreme resistance, tomato plants with Tm-22 gene still show partial resistance to ToBRFV. This weakened resistance can be boosted by increasing Tm-22 cells.
- Weakened ToBRFV strains that can be used for cross-protection against ToBRFV have been developed by the research team.
- A mixed infection of ToBRFV and PepMV induces severe symptoms, often causing crop termination.

Tomatoes at the markets showing Tomato Brown Rugose Fruit Virus (ToBRFV) symptoms. Photo: Aiming Wang