

From detection to risk assessment: Understanding the fate of plant viruses in organic waste fertilizers

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Recent developments and future trends
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Why this matters for diagnostics

Plant residues / waste

infected plant material
crop debris
organic waste streams



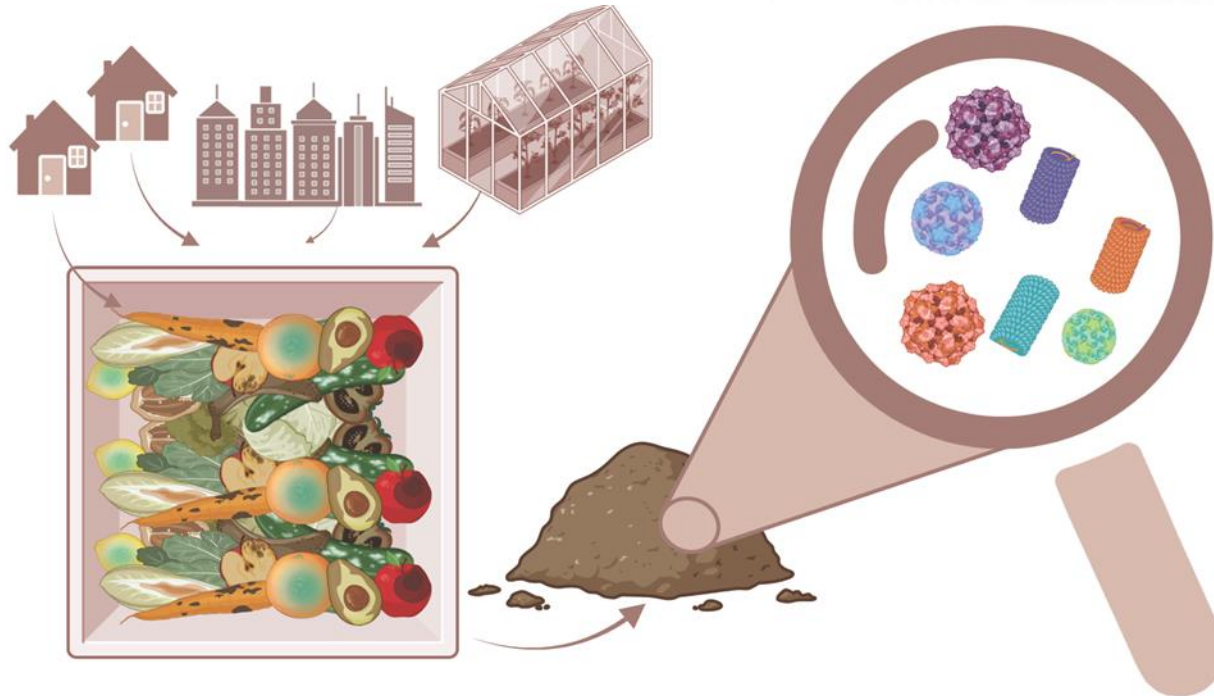
Organic fertilizer

compost
compost tea
insect frass



Crop exposure

soil application
substrate mixing
new plant contact



If infected plant residues enter these materials, viruses may persist and in some cases remain infective.

- **Detection?**
- **Risk assessment?**

The diagnostic challenge: difficult matrices, difficult interpretation

- Complex & heterogeneous matrices
 - Variable composition (poorly defined)
 - Inhibitors that affect nucleic acid extraction and amplification
 - Pathogen distribution may be uneven
- **A positive molecular signal does not automatically demonstrate infectivity or epidemiological relevance.**



Photo: Moj mali svet 03/26

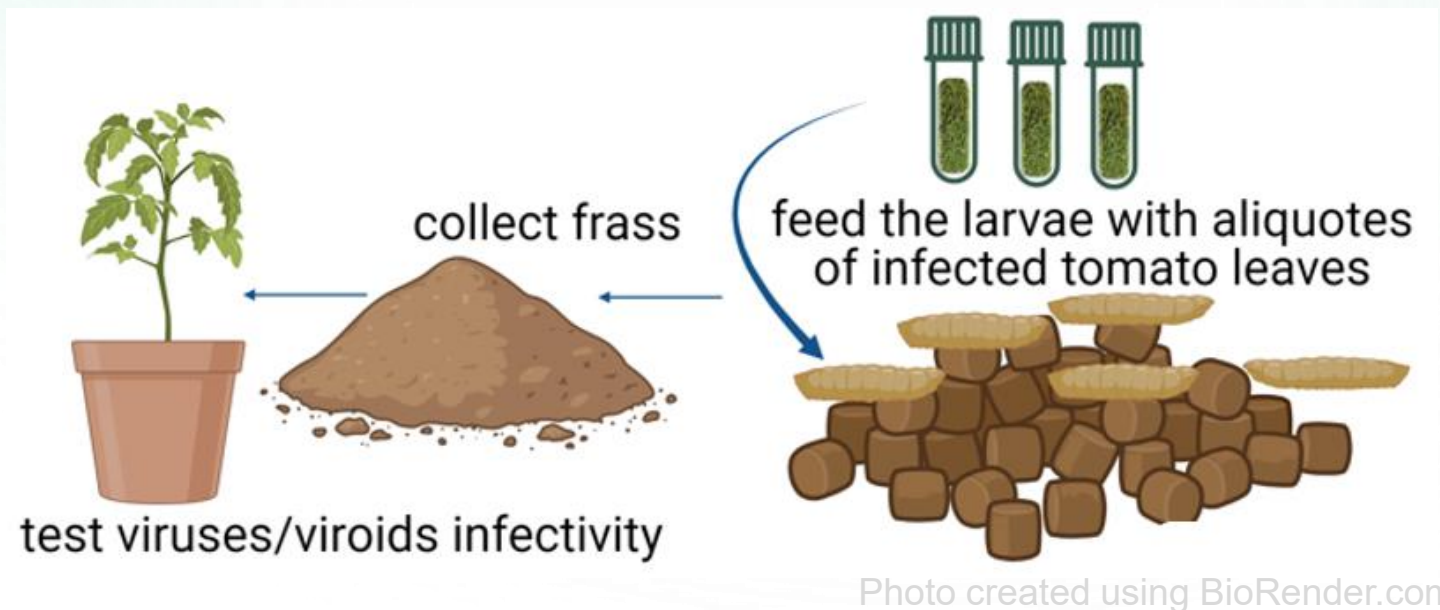
Our approach: from detection to biological relevance



Reliable detection:

- testing different nucleic acid extraction and concentration methods
- real-time PCR & HTS
- validation

➤ **The aim is not only to detect viral nucleic acids, but to understand what those findings mean for plant health risk.**

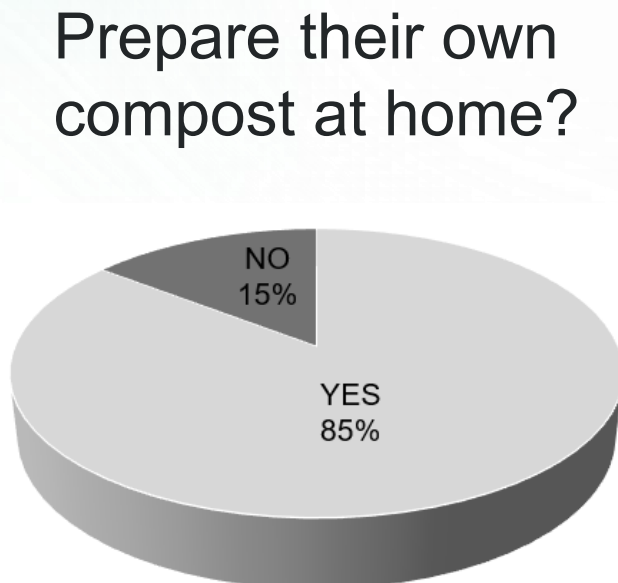
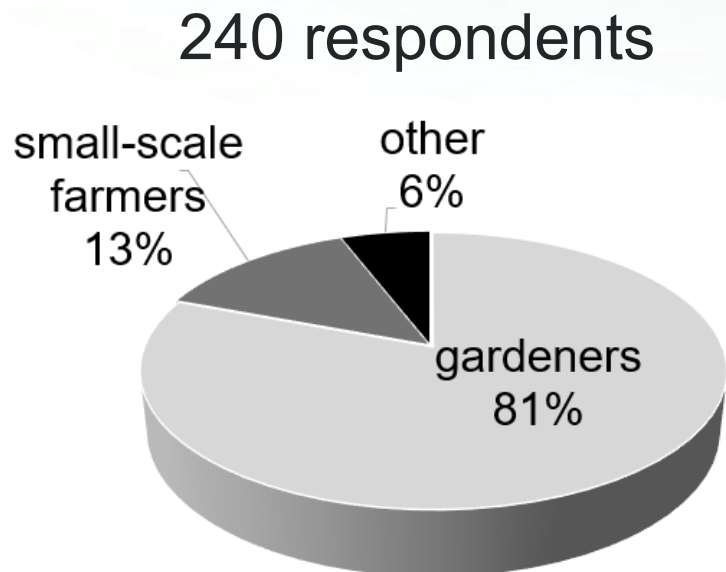


Biological relevance:

- persistence & transmission studies

Understanding the real-world context

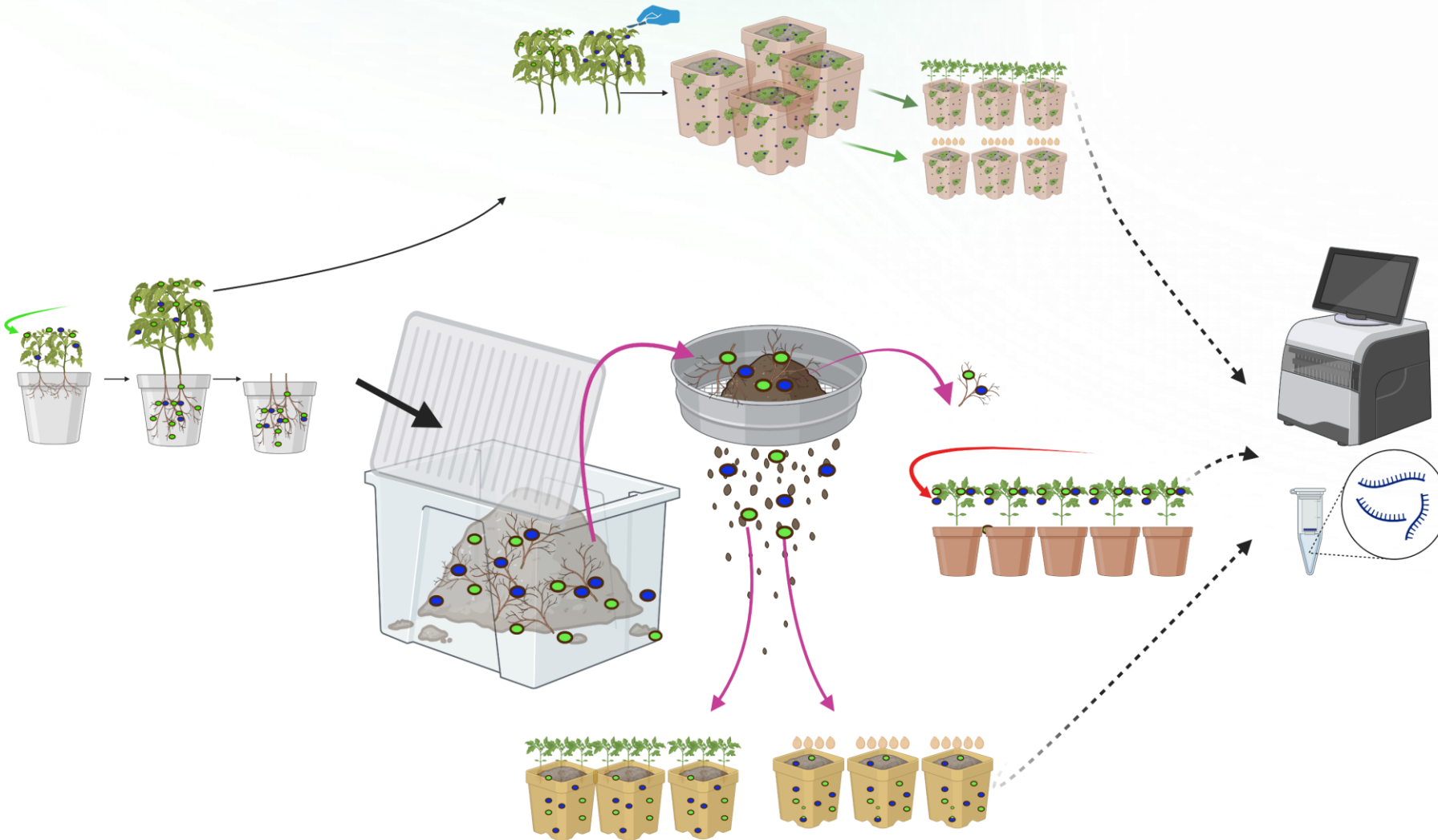
National survey (February-March 2026)



- diverse plant residues
- different types of manure
- frequently add soil, previous compost, microbial starters...

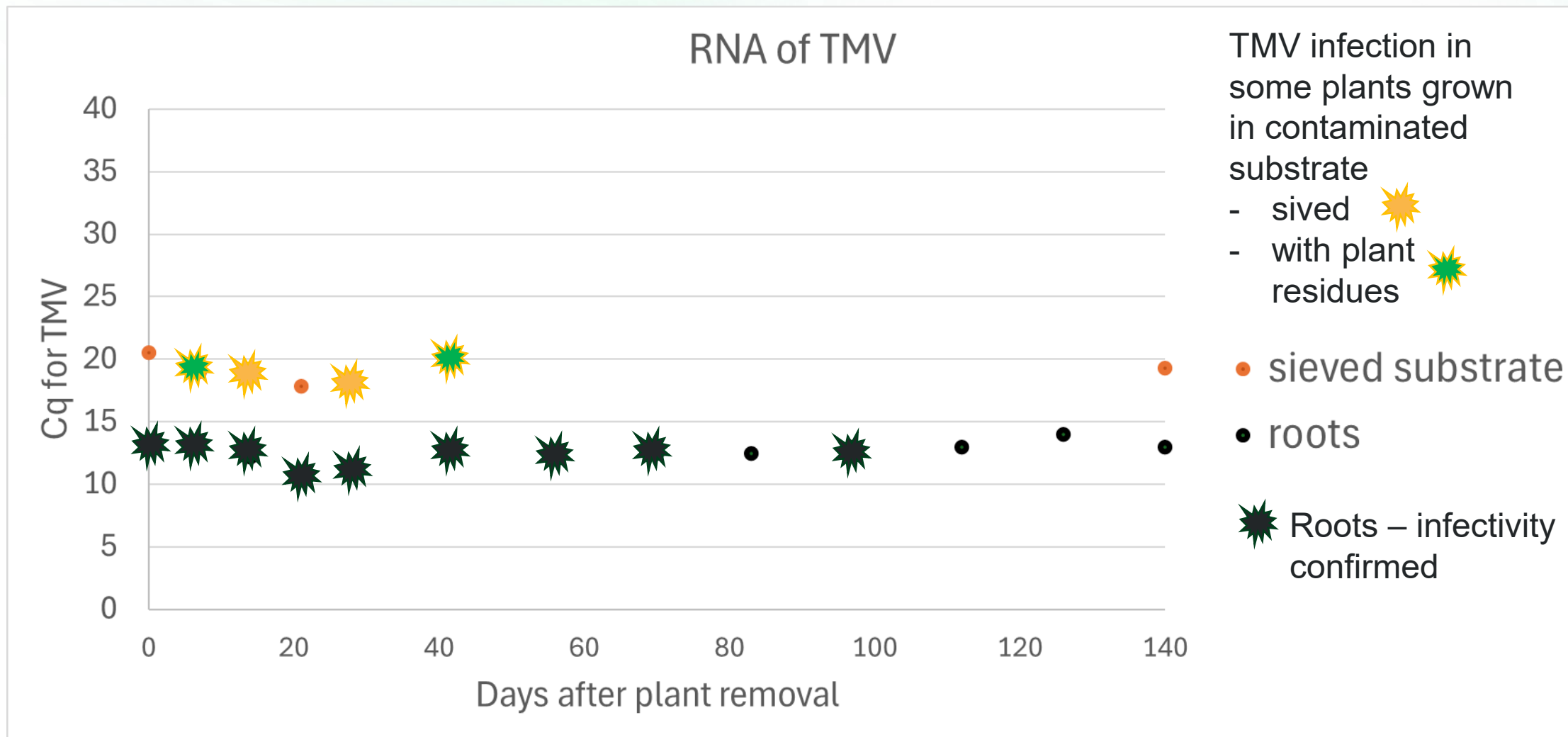
- **This confirms that these fertilizers are widely used and highly variable in composition, which reinforces the need for robust detection methods and careful interpretation of positive results when we assess virus-related plant health risks.**

TMV model experiment – Detection & survival in substrate and plant residues



How long after plant removal we can still detect TMV in these materials, and for how long this detection still corresponds to actual infectivity for new plants?

TMV model experiment – Detection & survival in substrate and plant residues



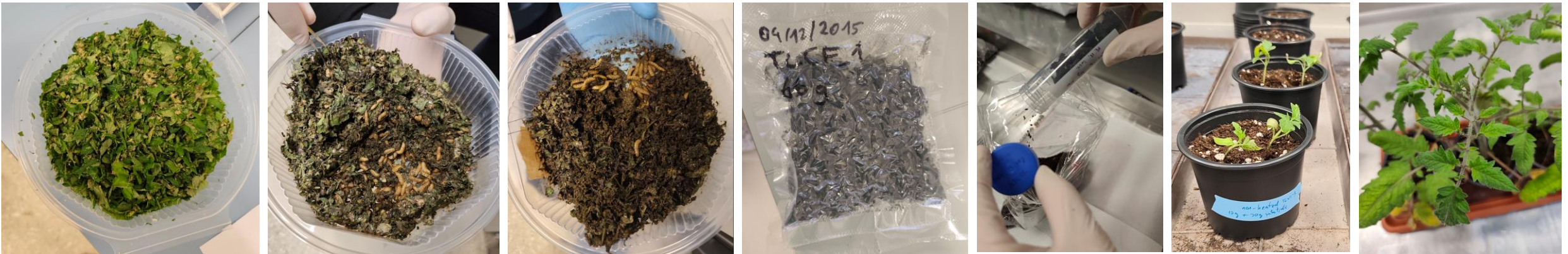
TMV RNA persists in these matrices for much longer than we can so far demonstrate infectivity in test plants.

Experimental systems: Virus detection & infectivity in fertilisers

Compost, comppost tea:



Frass:



- **Aim: to compare what we see at the molecular level with what we can actually confirm in terms of infectivity**

Take-home messages

- Even with a very stable virus (TMV), our data show that viral RNA can persist in substrate and in plant residues for a long time, while demonstrable infectivity in test plants is more limited in time and often much harder to show.
- **Molecular detection clearly outlives what we can currently confirm as biological risk.**
- We are now applying the same detection-versus-infectivity logic to compost, compost tea and insect frass. Aim: to understand not only whether these materials contain viral nucleic acids, but whether they can realistically act as sources of infection under practical conditions.
- **Positive molecular results in these kinds of complex fertiliser matrices are certainly important and should not be ignored, but they also should not be interpreted too directly as proof of transmission risk.**
- The real challenge – and the direction of our ongoing work – is to link detection with survival and infectivity, so that diagnostics can better support evidence-based plant health decisions.

Acknowledgements

Partners:



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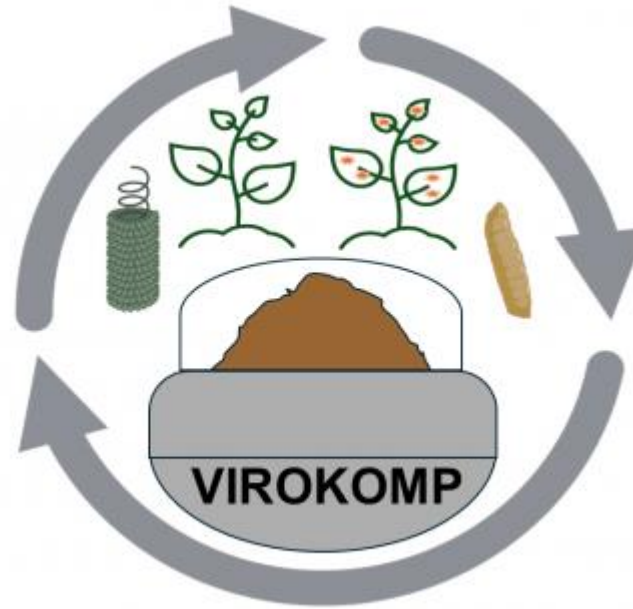
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Estimating risks associated with the presence and survival of plant viruses and viroids in compost and other organic waste fertilisers

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