

## Characteristics of viroids infecting horticultural plants

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Viroids are the smallest and simplest plant pathogens, consisting of a single-stranded, circular, naked RNA genome, 246–401 nucleotides long, lacking any protein-coding sequences. Potato spindle tuber viroid (PSTVd) and Tomato chlorotic dwarf viroid (TCDVd), belonging to the genus Pospiviroid, are two closely related pospiviroids. Tomato plants infected with the viroids are severely stunted, and their fruits are reduced in size, leading to economic losses. International trade may disperse the viroids globally via infected plants and seed.

In July 2006, we found TCDVd-infected tomato plants in a farmer's greenhouse in Hiroshima Prefecture, Japan. We characterized the host range and physical properties of the viroid. Finally, the disease was successfully eradicated from the farmer's greenhouse by this urgent eradication project. We developed a multiplex RT-PCR for the simultaneous detection of PSTVd and TCDVd and detected PSTVd in field-cultivated tomato plants in Fukushima Prefecture, Japan using this method<sup>1)</sup>. This is the first finding of PSTVd in field-grown tomatoes in Japan.

Although PSTVd is transmitted at high frequency by contaminated seeds, the molecular biology and histochemistry of this mechanism have not yet been fully analyzed. We therefore used *in situ* hybridization to analyze any differences in the distribution patterns of PSTVd and TCDVd in floral organs at each developmental stage of tomatoes. When distribution of TCDVd was compared with that of PSTVd, TCDVd was not detected in the outer integument around the embryo sac even though PSTVd was able to invade the outer integument, suggesting that such specific distribution reflects the frequent occurrence of viroid diseases in crops caused by PSTVd transmitted through seeds<sup>2)</sup>. Furthermore, we observed the patterns of PSTVd in floral organs after fertilization and mature seeds in each developmental stage of infected petunia, resulting that PSTVd is indirectly delivered to the embryo through the ovule or pollen during the development of reproductive tissues before embryogenesis<sup>3)</sup>.

These results thus contribute to developing the best practices for producing healthy seeds by the seed industry. Our studies also characterized pospiviroids that infect horticultural plants, contributing to the enhancement of seed inspection for plant quarantine systems and seed companies.

### References

- 1) Matsushita Y., Usugi T. and Tsuda S.: Eur J Plant Pathol 128: 165-170 (2010).
- 2) Matsushita Y., Usugi T. and Tsuda S.: Eur J Plant Pathol 130: 441-447 (2011).
- 3) Matsushita Y. and Tsuda S.: Phytopathology 104: 964-969 (2014).