

tobacco (25) and potato plants (26). In tobacco, the CP levels correlated with the level of protection against PVX infection. The majority of transgenic plants did not develop systemic symptoms after inoculation with up to 5 $\mu\text{g/mL}$ PVX, and accumulated very low levels of PVX in inoculated and systemic leaves. There were significantly fewer local infection sites on inoculated leaves of transgenic plants, compared to control plants. The results suggest that an early event in PVX infection was affected in the transgenic plants. However, in contrast to the TMV–tobacco interaction, protection was not overcome by inoculation with PVX RNA, indicating that virion disassembly was not the major step that was inhibited. The reduction in the number of local infection sites and in virus accumulation in inoculated leaves was also observed in RNA inoculated plants. There was no evidence for interference with long-distance spread of PVX. It is possible that an RNA effect contributed to protection, because expression of an antisense CP gene transcript also led to protection, but was far less effective than the positive-sense gene.

Transgenic potato plants that expressed the PVX CP gene alone or together with the CP gene from the potyvirus potato virus Y (PVY) accumulated CP and escaped infection by PVX after inoculation with up to 5 $\mu\text{g/mL}$ PVX (26). There was no detectable accumulation of virus in inoculated transgenic plants and no tuber transmission. The absence of even a low level of virus accumulation indicated that an initial event in PVX infection was inhibited. Since the study did not include RNA inoculations, it cannot be concluded whether this step was virion disassembly. The protection was virus-specific: There was no protection against PVY. However, double transgenic plants that accumulated both PVX and PVY CPs were protected against both viruses when inoculated separately or simultaneously. Transgenic plants expressing the PVY CP gene accumulated transcript levels that were comparable to those of plants expressing the PVX CP gene, but less CP. Studies on tobacco etch virus and other potyviruses suggest that CPMR against potyviruses is caused by an RNA effect rather than a protein effect (ref. 27; further discussed in Chapter 53).

6. Cucumber Mosaic Virus

Transgenic tobacco plants expressing the CP gene from the cucumovirus cucumber mosaic virus (CMV) do not develop systemic symptoms after inoculation with CMV virions or isolated RNA. However, virus accumulation in inoculated leaves could occasionally be observed (28). Protoplasts isolated from transgenic plants support CMV replication after electroporation with RNA, but not with virions. Apparently, both initial infection at the stage of virion disassembly and long-distance spread are inhibited in the transgenic plants.

A host-specific role in long-distance spread of CMV has recently been shown for the infection of cucumbers (29). Tomato aspermy cucumovirus (TAV) can