levels; resistance to heterologous tospoviruses appears to correspond with protein levels ***(19,20)***.

An alternative approach to achieving broader resistance is transformation of multiple CP genes within one plant expression vector. Lawson et al. ***(21)*** observed protection against PVX and potato virus Y (PVY) in transgenic potatoes expressing both CP genes. More recently, Prins et al. ***(22)*** transformed NCPs from TSWV, impatiens necrotic spot virus (INSV), and groundnut ringspot virus (GRSV), each under separate regulation in cauliflower mosaic virus (CaMV) 35S promoter/nopaline synthase (nos) 3' end cassettes, into tobacco. They obtained a transgenic line expressing the three genes that exhibited high levels of resistance to all three viruses.

Many of the systems analyzed for CP protection relied on mechanical inoculation of test plants. Other experiments involved inoculation by vectors, which more closely approximated the natural course for infection. CPMP was observed against aphid transmission of CMV ***(23,24)***, PLRV ***(25,26)***, and PVY ***(21)***. Resistance to the planthopper-transmitted rice stripe virus (RSV) was also demonstrated using CP technology ***(27)***. In contrast, expression of tobacco rattle virus (TRV) CP gene in transgenic tobacco conferred protection against mechanical inoculation with TRV, but protection was not observed against viruliferous vector nematodes.

4. Relationship Between Transgene Expression Levels and Degree of Protection

Although some of the earlier experiments with TMV, PVX, CMV, and AlMV exhibited a correlation between extent of protection and CP levels (*see* Part VI of this volume), this has not been observed in many cases. Several reports on potyviral systems indicated that CP levels were generally very low in plants expressing potyviral CP sequences, and frequently the lowest expressors were the best protected ***(9,21,28–31)***. Similar results have been reported in other systems (*see* Part VI of this volume). In addition, protection was observed in plants transformed with PLRV CP, although the protein could not be detected in transgenic plants ***(25,26)***. It remains to be determined if the lower expression levels of proteins in some systems reflects a technical difficulty with expression of certain genes, stability of the protein products, or absence of viral factors required for expression and/or stability. Although most reports involve genes expressed under the control of the CaMV 35S promoter, parameters relating to expression of genes, such as copy number and position effects may contribute to differences observed in the various systems.

Additional reports on potyviruses indicated that protection was better in plants expressing untranslatable TEV CP transcripts than in plants expressing CP ***(10–12,32,33)***. Dougherty et al. ***(33)*** proposed that protection is because of