and extent of protection may reflect differences in mechanisms of protection in response to different virus systems (further discussed in Chapters 52 and 53).

5. Protection Conferred by Expression of Other Viral Genes and Sequences

A few years after development of CPMP, transgenic plants were also engineered to express other viral sequences and genes (**Table 2**), including antisense RNAs ***(5,6,10,11,18,32,34–41)***, satellite RNAs ***(39,42-44)***, sense transcripts ***(12,32,34,45)***, defective-interfering (DI) sequences ***(46,47)***, replicase genes ***(48–54)***, protease genes ***(55,56)***, and movement protein genes ***(57,58)***. Several reviews have been published on these strategies ***(59–63)***.

As with CPMP, transgenic plants expressing other viral sequences display resistance phenotypes ranging from delay in symptom development to apparent immunity. In addition, discussions on mechanisms of protection also focus on potential correlations between transgene expression levels and extent of protection. The diversity of protection phenotypes in response to different genes and sequences offers multiple choices for engineering virus resistance into desired crops, but compounds the problem of interpretating mechanisms associated with genetically engineered resistance.

6. Summary

A decade of research has proven that plants can be genetically engineered to resist virus infection through expression of viral CP genes, as well as other viral genes and sequences. Additional opportunities for development of resistant plants will require research focused on mechanisms of protection, improvements in expression vector design, and transformation of new crop species. As each of these technologies is utilized singly or in combination to generate resistant crop varieties, the full impact of such engineered resistance will be realized.

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