Because of their stability and ease of purification, plant viruses were a natural candidate for antibody technology. Although many uses of serology were developed initially in medical fields, plant virologists have quickly adapted these techniques for identification and detection. Among the methods emphasized in recent years is enzyme-linked immunoassay (ELISA), which has been popular since its development and adoption to plant virology in the late 1970s (**ref. *17***; *see* Chapters 29 and 46). Popular nucleic acid-based detection methods include dot-blot hybridization (*see* **ref. *18***), and polymerase chain reaction, which quickly became popular in the mid-to-late 1980s because of its extreme sensitivity (e.g., **ref. *19***; *see* Chapters 47 and 48).

A method of nucleic acid analysis that has been more widely used in plant virology than animal virology for detection, identification, and characterization is dsRNA analysis directly from infected tissue (*see* **ref. *20*** for review). Several factors and observations have led to the popularity of dsRNA analysis as a detection and characterization method. As noted earlier, roughly three-fourths of all plant viruses contain ssRNA of positive polarity. The dsRNA replicative forms of these viruses can be isolated and analyzed rapidly and easily. If accurate size standards are used, the family or group to which a virus belongs can be predicted based on its dsRNA profile. In addition to its usefulness as a detection method, subgenomic RNAs are often easily identified by dsRNA analysis, providing a tool for rapid prediction of RNAs involved in virus gene expression.

7. Viroids, Satellites, and Defective-Interfering RNAs

Small RNAs (<400 nucleotide residues) are relatively common in plants (*see* **ref. *1*** for discussion). Viroids replicate autonomously and are not packaged. Satellites and defective-interfering (DI) RNAs require a helper virus for replication, and are packaged. DI RNAs are derived from their helper viruses, but satellites share little if any common sequence with the helper virus genome. Viroids are pathogenic; satellite and DI RNAs may intensify or reduce viral symptoms. Study of these subviral RNAs is important for a number of reasons. Their small sizes permit rapid study of residues involved in replication, packaging, and symptomatology. Symptom-attenuating satellite and DI RNAs may be useful for protection against infection by the parent virus. They are potentially excellent vehicles with which to hunt for host factors involved with virus replication. Methods for study of these small RNAs are similar to methods for studying larger RNAs, but their small sizes and tighter structures usually allow easy fractionation away from other nucleic acids.