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Introduction to Classical Crossprotection

Ron S. S. Fraser

1. History

In the first three decades of the 20th century, it was shown that a number of plant diseases could be transmitted by infectious sap that had been passed through a bacteria-proof filter. Plant virus particles had yet to be identified and characterized, and much of the research effort of plant virologists went into describing disease symptoms and studying methods of transmission. In the late 1920s, it became apparent that, when plants were deliberately inoculated with two agents causing different types of visible symptom, there could be a form of interference.

Wingard *(1)* found that, in tobacco and other hosts infected with tobacco ringspot, new growth appeared that did not show any signs of disease. It was not possible to cause ringspot symptoms on these leaves by a further direct inoculation. Nevertheless, sap from these symptomless leaves caused ringspot when inoculated to healthy plants. McKinney *(2)* noted that tobacco plants infected with a light green mosaic (now known to be tobacco mosaic virus) did not develop further symptoms when inoculated with a yellow mosaic form. In contrast, plants infected with a mild, dark green mosaic form did develop yellow symptoms when reinoculated with the yellow form.

Further work on such interactions between viruses was facilitated by the developing ability of plant virologists to discriminate between different viruses, or isolates of the same virus, using differential hosts and the emerging techniques of serology and virus particle characterization. It was recognized early that interference occurred primarily between closely related viruses, and the term "crossprotection" was applied to indicate this relatedness. Indeed, crossprotection was used as one diagnostic test for relatedness between virus isolates *(3,4)*. However, more modern approaches using nucleic acid sequenc-

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