

fine pores would not be so readily drained as coarser pores containing less phosphorus, it is suggested that the concentration of available phosphorus in the fine pores may be considerably higher than has been indicated earlier by workers using displacement techniques.

A more detailed report of this work is being prepared for publication elsewhere.

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VIROLOGY

Potato Virus M and Paracrinkle

IN a recent communication under this title, Howard and Wainwright¹ confirmed earlier reports²⁻⁴ that potato plants of the variety King Edward contain potato virus *S* plus paracrinkle virus. The communication calls for comment and elaboration because it suggests a uniformity of infection in King Edward plants that conflicts with my experience. During the past two years I have tested many plants from seven different commercial stocks of King Edward, and most contained both viruses; but about 90 per cent of the plants in two of the stocks contained only paracrinkle virus, and one plant contained only virus *S*. This plant is the only one of the many hundreds tested by different workers since Salaman and Le Pelley's⁵ original work which did not contain paracrinkle virus.

The origin and behaviour of paracrinkle virus have long continued to stimulate speculation and experiment. To account for the variation in symptoms when Arran Victory was grafted with scions from King Edward, Salaman suggested that King Edward contained two viruses of which occasionally only one was transmitted⁶. However, after it became clear that his suggestion was unacceptable, it became generally accepted that only one virus was involved. For long, too, this virus was thought to be unique to King Edward potatoes and to be transmissible only by grafting. All this is now known to be untrue. Paracrinkle virus was some years ago transmitted by mechanical inoculation of sap⁷, and was found to be remotely related serologically to other viruses such as carnation latent virus, which has been transmitted by aphids, and potato virus *S*, which has not^{4,8}. Potato virus *S* occurs in many potato varieties, including Arran Victory, so there was the obvious possibility that the severe disease caused in this variety by grafts from King Edward resulted from joint infection with viruses *S* and paracrinkle. My primary purpose in freeing a clone of Arran Victory from potato virus *S* (ref. 9) was to see what symptoms paracrinkle virus alone would cause. To ensure cultures of paracrinkle virus free from virus *S*, I inoculated tomato plants, which are hosts for paracrinkle virus but not for virus *S*, with sap from King Edward leaves and later grafted scions from the

tomato plants to virus-free Arran Victory potato plants. Individual Arran Victory plants varied greatly in their reaction; some showed the typical severe paracrinkle, others showed symptoms more resembling those called leaf-rolling mosaic, and still others developed only a chlorotic blotching with little leaf deformity. The range was much the same as when Arran Victory containing virus *S* are infected. Hence, there is no doubt that paracrinkle virus alone can cause a severe crinkling disease in Arran Victory. Virus *S* seems to contribute little to the effects, and the variation in symptoms shown by Arran Victory plants infected with only paracrinkle virus probably means that this, like most other viruses, occurs in strains that differ in virulence.

Plants of several potato varieties suffering from leaf-rolling mosaic have been found to contain a virus that has been called *M* and shown to be closely related serologically to paracrinkle virus⁴. After Wetter and Völk found that virus *M* could be transmitted by the aphid *Myzus persicae*¹⁰, it seemed that the transmissibility of paracrinkle virus by aphids should be re-investigated. The tests I have made show that some stocks of King Edward contain strains of the virus that are transmitted by *Myzus persicae*, whereas from others, which gave similar symptoms when grafted on to Arran Victory plants, the aphid has failed to transmit anything. I am now surveying commercial stocks of King Edward to get some idea of the frequency with which aphid-transmitted strains occur.

The present position can be summarized briefly: most King Edward plants contain paracrinkle virus and virus *S*, some contain only paracrinkle and a few only *S*. The paracrinkle virus in different plants differs in its virulence (some strains are indistinguishable from virus *M*) and in its transmission by *Myzus persicae*.

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THE discovery by Dr. B. Kassanis that 90 per cent of plants in two stocks of King Edward contained only paracrinkle virus and were free from virus *S* suggests that virus *S* entered King Edward stocks later than did paracrinkle virus (virus *M*). The King Edward used by us¹ was possibly derived from Salaman's original material, as the plants investigated were the descendants of occasional Red King mutants found in a stock being propagated by the National Institute of Agricultural Botany and which had originally been supplied by Salaman². Similarly, the King Edward stock investigated by Bagnall, Larson and Walker³ in the United States, and which also contained both viruses *S* and *M*, was obtained indirectly from Salaman. This suggests that the