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Association of a Rhabdovirus With Yellow Vein Mosaic, A New Disease of Citrus

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ABSTRACT. A pummelo tree at Bangalore was observed to develop yellow mosaic symptoms on the leaves. These symptoms were transmitted to healthy pummelo seedlings by tissue grafting. Bacilliform virus particles resembling rhabdoviruses were found in preparations from both the field affected tree and the glasshouse inoculated plants. This is the first report of this apparently new disease.

Pummelo also known as shaddock, is a popular dessert fruit in South and Southeast Asia and in India it is widely grown mostly for local consumption. It is known to be susceptible to several important diseases such as greening (5), tristeza (6), exocortis (3) and impletatura (1). Recently, a new serious virus-like disease was observed on pummelo near Bangalore.

On young leaves, the initial symptoms began as yellow flecks or dots which later developed into mottling and bright yellow flecking along the veins (Fig. 1). Some of the flecks fused together forming either rings or large chlorotic areas. An investigation was carried out to determine the etiology of this disease.

Six healthy pummelo seedlings, grown in an insect-proof glasshouse at

Delhi, were wedge grafted with affected budwood while six other seedlings were leaf patch grafted with veinal tissue. Five plants each of pummelo, *Nicotiana glutinosa*, *N. benthamiana*, *Chenopodium amaranticolor*, *C. quinoa*, *Catharanthus rosea* and *Petunia hybrida* were sap inoculated with the inoculum prepared by grinding infected leaf tissue in liquid nitrogen and extracting the sap in phosphate buffer (pH 7.4) in a ratio of 1:1 (w/v).

All the graft inoculated pummelos developed typical symptoms within 70 days of inoculation (Fig. 2). None of the sap inoculated plants developed any symptoms up to 8 weeks after inoculation.

Leaf tissue of field and glasshouse plants taken from areas showing yellow spots and vein banding were ex-



Fig. 1. Leaves from naturally infected pummelo tree showing yellow vein mosaic symptoms.



Fig. 2. Leaves from glasshouse inoculated pummelo plant with conspicuous vein flecking and mosaic symptoms.

tracted in phosphate buffer (pH 7.0). Electron microscope grids coated with carbon film were floated on the extracts, stained with uranyl acetate as described by Gibbs *et al.* (7) and examined in a Jeol CXII transmission electron microscope at 80 KV. Many bacilliform particles measuring 166×36 nm (Fig. 3) were observed in samples from field-affected and glasshouse-inoculated pummelo plants. No such particles were detected in any

sample from healthy leaves of pummelo or glasshouse inoculated herbaceous plants.

Citrus mosaic diseases have been reported on Satgudi in Andhra Pradesh (4), Khasi mandarin in North-east India (2) and Satsuma mandarin in Japan (8). Isometric virus particles are reported to be associated with these diseases (10, 11) which are also sap transmissible. The association of bacilliform particles with diseased plants and the failure of sap transmission of the present virus distinguishes the yellow vein mosaic disease of pummelo from those reported earlier. The particles observed resemble rhabdoviruses in size and surface structure. Association of a similar bacilliform virus has also been reported with leprosis disease of grapefruit and sweet orange in Brazil (9). The symptoms of leprosis are, however, distinct from those of yellow vein mosaic, indicating that the two diseases are different. We propose the name of this disease to be pummelo yellow vein mosaic and the associated virus as pummelo yellow vein mosaic virus (PYVMV), a tentative member of *Rhabdoviridae*.

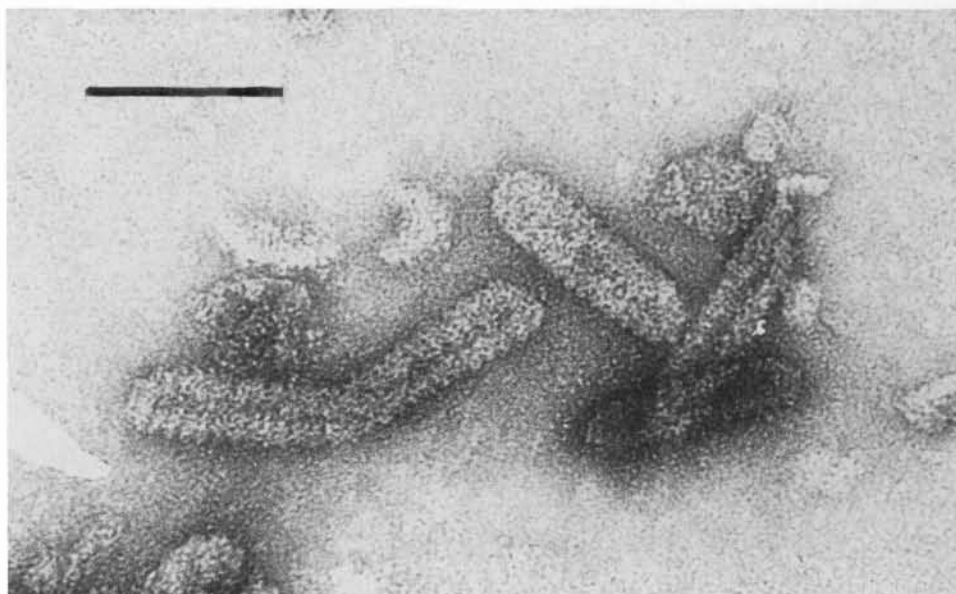


Fig. 3. Electron micrograph of rhabdovirus-like particles from mosaic affected pummelos. Bar = 100 nm.

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