Role of a Whitefly-Transmitted Agent in Infection of Sweet Potato by Cucumber Mosaic Virus

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ABSTRACT

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Cucumber mosaic virus (CMV) severely infects sweet potato fields in Israel causing stunting, chlorosis, and yellowing of plants. Transmission of CMV to healthy sweet potato plants failed. Infection depends on the presence of a whitefly-transmitted agent and not on sweet potato feathery mottle virus, as reported previously.

We have reported that cucumber mosaic virus (CMV) severely infects sweet potato fields in Israel causing stunting, chlorosis, and yellowing of plants (2). All plants infected with CMV also carried sweet potato feathery mottle virus (SPFMV) (5,6). Healthy sweet potato plants obtained from meristems and free of SPFMV did not become infected with CMV by mechanical, graft, or aphid inoculations. We thought that the presence of SPFMV was required to infect sweet potato with CMV.

Recently, we observed that sweet potato infected by SPFMV also carried a whitefly-transmitted agent (*unpublished data*). Only the dual infection of sweet potato with SPFMV and by the whitefly-transmitted agent caused marked feathery mottle symptoms of vein yellowing and chlorosis. Infection of sweet potato with SPFMV or by the whitefly-transmitted agent alone caused only mild symptoms.

The purpose of this work was to determine whether the infection of sweet potato by CMV depends on the presence of SPFMV, a whitefly-transmitted agent, or both.

MATERIALS AND METHODS

Plants. Sweet potatoes (*Ipomoea batatas* (L.) Lam. 'Georgia Jet') obtained from meristem cultures (apparently virus-free by repeated graftings to *I. setosa* Ker. and to sweet potatoes infected with SPFMV) were propagated by cuttings. Plants infected with only SPFMV were obtained by aphid transmission with *Myzus persicae* (Sulzer) from sweet potato plants doubly infected with SPFMV and the whitefly-transmitted agent to *I. setosa*. Subsequently, three transfers from *I. setosa* to *I. setosa* were done with single aphids. Between transfers, there was an interval of 2–3 wk to allow buildup of the virus. After that, the virus was aphid-transmitted to healthy Georgia Jet sweet potatoes. Positive reactions were obtained with an SPFMV antiserum in enzyme-linked immunosorbent assay (ELISA). Attempts to recover a whitefly-transmitted agent from these plants were negative.

Plants infected by only the whitefly-transmitted agent were obtained by whitefly transmissions with *Bemisia tabaci* (Gennadius) from sweet potato plants doubly infected with SPFMV and the whitefly-transmitted agent to healthy Georgia Jet plants. At least 100 individuals were caged on a source plant. After 48 hr, the whiteflies were placed on acceptor plants for 4 days. Subsequently, another transfer was done from these sweet potatoes to healthy sweet potatoes. Graft-inoculation from these plants to *I. setosa* caused small yellow leaves and stunting. Both the whitefly-inoculated sweet potato and the graft-inoculated *I. setosa* plants reacted negatively in ELISA with an SPFMV antiserum, and no SPFMV or other potyviruslike particles or pinwheels were observed in thin sections by electron microscopy.

Cucumber mosaic virus. Three isolates of CMV—two originating from sweet potatoes and one from cucumber—were used. The isolates from sweet potatoes were transmitted by aphids to cucumbers and from cucumbers mechanically to *I. nil* (L.) Roth 'Scarlet O'Hara'.

Serology and electron microscopy. ELISA was done according to Clark and Adams (1) with the use of antisera against CMV isolate Price's No. 6 (CMV-6) (4) and SPFMV (3). Immunoglobulins and conjugates were used at dilutions of 1:1,000, and leaf homogenates were diluted 1:10 (v/v) in phosphate-buffered saline (0.02 M phosphate, 0.15 M NaCl, and 0.0026 M KCl, pH 7.4) containing 0.05% Tween 20 and 2% polyvinylpyrrolidone. A Bio-Tek Instruments ELISA reader model EL 310 was used.

Virus samples for electron microscopy were negatively stained with 2% uranyl acetate after partial purification from sweet potato leaves (3). For decoration, antisera were diluted 1:20 with 0.1 M phosphate buffer, pH 7.0. Grids were not precoated with antisera.

RESULTS AND DISCUSSION

CMV-infected *I. nil* scions were grafted to healthy sweet potato plants or to sweet potato plants infected with SPFMV, the whitefly-transmitted agent, or the combination of SPFMV and the whitefly-transmitted agent. After inoculation, infection with one strain of CMV from sweet potato resulted in five out of five of the plants being infected by the whitefly-transmitted agent and five out of five of the plants being infected by both the whitefly-transmitted agent and SPFMV. No transmission of CMV was obtained in healthy sweet potato plants and those infected with SPFMV. Presence of CMV was confirmed by ELISA. Similar results were obtained with the two other isolates of CMV. Symptoms on sweet potato caused by the three isolates were similar (Fig. 1).

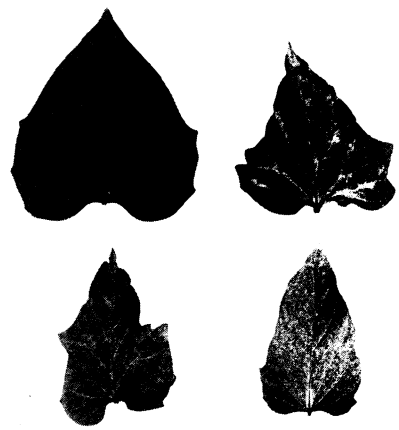

Fig. 1. Veinclearing and deformation in sweet potato leaves from plants carrying the whitefly-transmitted agent, graft-inoculated with cucumber mosaic virus. Upper left leaf = healthy control.

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Mechanical and aphid inoculations gave similar results, i.e., infection of sweet potato by CMV was obtained only if the acceptor plants were already infected with the whitefly-transmitted agent.

In conclusion, the presence of another virus is required for replication or translocation of CMV in sweet potato. Apparently, the infection of sweet potato with CMV requires the presence of a whitefly-transmitted agent(s) and not SPFMV (3). It seems that our previous test material contained a whitefly-transmitted agent(s) in addition to SPFMV.

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