Occurrence and Detection of Citrus Vein Enation Virus in Huangyan, Zhejiang, China

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ABSTRACT. Characteristic small vein enations induced by the citrus vein enation virus (CVEV) were observed on the underside of leaves of 11 citrus varieties and hybrids in orchards in Huangyan, Zhejiang Province, China. Woody gall symptoms were not observed because susceptible rootstocks were not used. CVEV was confirmed by topworking buds of virus-free Volkamer lemon onto field trees, and by indexing on seedlings of Rangpur lime, Bendizao mandarin, Volkamer lemon, rough lemon and Brazil and Daidai sour orange.

Index words. Citrus vein enation virus, occurrence, detection, China.

Citrus vein enation virus was described originally by Wallace and Drake (12) in California in 1953, and has since been detected in many citrus growing regions around the world (1, 2, 5, 8, 9, 11). Woody gall development in rough lemon has been shown to be caused by the same virus (13). It is transmitted in a persistent manner by a number of aphid species (6, 7), and 28-nm isometric particles have been isolated from infected tissue (4).

Roistacher and Nauer (10) reported the detection of CVEV in Paak Ling Mung sweet orange which had been introduced into the United States from China. Between 1990 and 1994 we conducted surveys for vein enation symptoms in citrus orchards in Huangyan, Zhejiang Province, and carried out indexing tests by top working field trees and inoculating indicator seedlings in the screenhouse. A preliminary report has been published (3).

MATERIALS AND METHODS

About 300 trees of 30 citrus varieties and hybrids including sweet orange, sour orange, mandarin, pummelo and lemon were examined. Ten spring and 10 autumn shoots on 10 trees of each variety were examined for vein enations, and trunks and rootstocks were examined for woody galls.

Seedlings of Rangpur lime, rough lemon, Mexican lime, Bendizao mandarin and Brazil and Daidai sour orange were grown in pots in an insect-proof screenhouse at temperatures below 30°C. Two to four budsticks or twigs with two to three buds were inoculated onto two to three seedlings per candidate tree. After two months, they were cut back and new growth was observed for symptoms. Self-grafted seedlings were used as negative controls.

For topworking, five virus-free Volkamer lemon buds were grafted onto symptomatic field trees. The trees were sprayed periodically with insecticide to control aphids. Volkamer lemon buds were grafted onto 2-yr old citrange seedlings as controls.

RESULTS AND DISCUSSION

Characteristic vein enation symptoms were observed on 11 citrus varieties or hybrids including Bendizao mandarin, New Ben No.1 (an almost seedless Bendizao selection), Ponkan mandarin, Mangju, Zaoju, satsuma mandarin, Zhuhong, Hongyukan (a Bendizao hybrid), Ruju, Meyer lemon and Washington navel. The degree of enation formation was higher in the spring shoots (20 to 88% of leaves) than in the autumn (0.5 to 19%). The number of enations varied from one to six per leaf, with Bendizao and Zaoju tending to produce more enations than the other varieties. No woody galls were observed on any trees.

Vein enations appeared on the new leaves of all the indicator spe-

cies graft-inoculated with buds of all 11 varieties and hybrids 6 to 8 weeks or more after inoculation. More enations developed on sour orange, Rangpur lime and Bendizao mandarin seedlings than on rough lemon or Mexican lime. When inoculated Rangpur lime seedlings were kept at 30 to 35°C, 3 to 5% of the leaves developed symptoms. However, when plants were maintained at 22 to 26°C this was increased to 47 to 52%. No symptoms appeared on the negative controls.

When Volkamer lemon was topworked onto trees of Bendizao, New Ben no.1, Mangju, Zaoju and satsuma, 0.2 to 11% of the leaves showed enations 40 to 50 days after grafting. No enations appeared on the leaves of the negative controls.

We have shown that CVEV is widespread in the Huangyan citrus growing area of Zhejiang Province, causing leaf symptoms on several varieties. Since rootstock varieties that develop woody galls were not used, no woody galls were observed. This widespread occurrence is probably due to the use of infected budwood, and the common presence of known aphid vectors of CVEV in the orchards.

Our findings also confirm the earlier suspicion that CVEV is present in China (10). The virus has probably been present in Huangyan, which has been a well known citrus producing area for over 1500 years.

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