SYNERGISTIC REACTIONS BETWEEN THE PATHOGENS OF CITRUS GREENING AND SEEDLING-YELLOWS

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ABSTRACT

Evidence has been obtained indicating synergistic reactions between the pathogens of citrus greening and seedling-yellows. Irrespective of sequence of inoculation to budlings of Ladu, Ponkan and Szinkom mandarins on Calamanderin and Florida rough lemon rootstocks, combined infection of the pathogens produced more severe leaf symptoms and more stunting; a greater number of plants collapsed earlier than those infected with the greening pathogen alone. The results demonstrate that the presence of the seedling-yellows virus in greening-infected orchard trees in the Philippines might have contributed to the decline and death of numerous citrus trees in the last 14 years.

INTRODUCTION

Simultaneous infections of two or more unrelated viruses are known to induce a more severe effect or injury on the host plant than infections of a single virus (Rochow and Ross, 1955; Ross, 1957, 1959). Weather (1959, 1960, 1961) demonstrated that citrus plants dually infected with yellow-vein and vein-nation viruses exhibited more severe yellow-vein symptoms than plants infected only with yellow-vein virus. Similarly, plants doubly infected with the viruses of psorosis and yellow-vein developed more severe leaf symptoms of psorosis and more stunting than those infected with psorosis virus alone (Weather, 1961).

This paper describes the study on the synergistic reactions between the pathogens of citrus greening and seedling-yellows. The preliminary results have already been published elsewhere (Martinez and Wallace, 1969).

MATERIALS AND METHODS

Young budlings of Ladu, Ponkan and Szinkom mandarins on Calamanderin and Florida rough lemon rootstocks were inoculated separately and simultaneously by tissue grafting with the seedling-yellows and greening pathogens. Non-inoculated budlings of each stionic combination were maintained as control plants. In another test, budlings of the same stionic combinations used in the preceding experiment were treated similarly except that in the doubly-infected groups, seedling-yellows virus was introduced 3 to 4 months before the greening pathogens, or vice versa.
RESULTS AND DISCUSSION

The budlings inoculated with the seedling-yellows virus alone developed no symptoms other than slight stunting and reduction in size of leaves. Those with the greening pathogen alone exhibited severe stunting, yellowing and mottling. Dual infection of both pathogens resulted in symptoms similar to but more severe than those of plants with the greening pathogen alone. In addition, a greater number of doubly-infected plants collapsed earlier.

The symptom expressions did not vary regardless of whether the citrus greening and seedling-yellows organisms were inoculated simultaneously or separately one after the other after 3-4 months. The control plants remained healthy in all cases.

The increase in severity of leaf symptoms, growth retardation and earlier collapse of dually infected plants is apparently due to an increased activity of the greening pathogen in the presence of seedling-yellows virus, or to the combined effect of both pathogens. Various workers (Rochow and Ross, 1955; 1957, 1960; Weathers, 1961) have reported interactions between viruses in dual infections wherein there is an increase in the activity of one virus in the presence of another. The synergistic reactions of the pathogens of greening and seedling-yellows are similar to those reported for the viruses of psorosis and yellow-vein (Weathers, 1960, 1961; Weathers and Greer, 1968). It could be that the seedling-yellows virus stimulated the multiplication of the greening pathogen. In the absence of techniques for measuring concentration of the involved pathogens, however, it cannot be determined whether this actually occurs. On the other hand, the increase in severity of symptoms may have resulted simply from a combined action of the two pathogens. It is known that severe strains of tristeza and seedling-yellows viruses have detrimental effects, even though slight, on the most tolerant stonic combinations. Combining this injury with that caused by the greening pathogen may have resulted in the more severe effects on and early collapse of the experimental trees.

It has been established earlier (Martinez and Wallace, 1967, 1968, 1969) that the greening disease is responsible for much of the decline and death of citrus trees in the Philippines since 1957. In the light of the present findings, however, it is evident that the seedling-yellows virus has been contributing, to some extent, to the deterioration of orchard trees in the province of Batangas. Seedling-yellows is widely distributed in the Philippines and it has been found in all orchard trees that were indexed (Martinez, Nora and Sebastian, 1965). Thus, it is not possible to measure the effects of greening pathogen alone on orchard trees. This pathogen is the primary cause of the serious decline of citrus in the Philippines, but the present study indicates that the seedling-yellows virus at least speeds up the decline when combined with the greening pathogen.
LITERATURE CITED


