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Comparative Aphid Transmission of a Common Citrus Tristeza Virus Isolate and a Seedling Yellows Isolate Recently Introduced into Spain

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ABSTRACT. Comparative tests of transmission efficiency have been performed using various aphid species and T-300, an isolate of citrus tristeza virus (CTV) widely distributed in Spain, and T-387 a seedling yellows tristeza isolate (CTV-SY) recently introduced into this country. The aphid species tested were those most abundant on citrus in Spain; *Aphis citricola*, *Toxoptera aurantii*, *Myzus persicae*, and *Aphis gossypii*. A minimum of 200 aphids were used for each test plant. Sweet orange was used as a donor and Mexican lime as a receptor. *Aphis gossypii* transmitted T-387 with lower efficiency (60%) than T-300 CTV (90%). *A. citricola* transmitted the two isolates with a very low efficiency. No transmission was observed with *T. aurantii* or *M. persicae*.

The transmission efficiency of citrus tristeza virus (CTV) by the most abundant aphids (Homoptera Aphididae) in Spanish citrus areas was determined previously (3). *Aphis gossypii* was an efficient vector of the two CTV isolates assayed whereas *Aphis citricola* and *Toxoptera aurantii* transmitted one of them poorly. The other aphid species tested failed to transmit either tristeza isolate.

Recently a seedling yellows tristeza isolate (CTV-SY) has been detected in Spain (1), but its aphid transmissibility was unknown.

The most abundant aphid species in the area (5), *A. citricola*, *T. aurantii*, *Myzus persicae*, and *A. gossypii*, were used in this study. In this paper we report the results of experiments to determine the transmission efficiency of the newly discovered CTV-SY isolate by these aphids, in comparison with a common CTV isolate.

MATERIALS AND METHODS

Two CTV isolates were used in our aphid transmission tests. The T-387 isolate is a seedling yellows isolate (CTV-SY) which has been recently introduced into Spain via infected budwood (1). The T-300 isolate of CTV does not cause seedling yellows and is representative of CTV isolates common in Spain (4).

Methods were similar to those used previously (3). Donor plants

were Pineapple sweet orange seedlings and receptor plants were Mexican lime seedlings about 30 cm tall. *A. citricola* and *T. aurantii* were collected from field citrus trees and the others were reared in controlled environment growth chambers (22 ± 1.5 C, $70 \pm 10\%$ relative humidity and a 15-h photoperiod at 700 lux). *Myzus persicae* was reared on broad bean and *A. gossypii* on cotton. Transmission experiments were carried out in these chambers, using transparent, rigid plastic tubes 8 cm long and 3 cm in diameter as transmission cages. Acquisition and inoculation times were 48 h each.

Ten Mexican lime receptor plants were used for each aphid species and virus isolate. Two hundred aphids were employed per receptor plant for *A. citricola*, *T. aurantii* and *M. persicae*, and 400 for *A. gossypii*. A combination of adults and nymphs of different ages were used.

After inoculation, receptor plants were transferred to a greenhouse with temperatures ranging from 18 C to 25 C. Plants were checked for foliar symptoms periodically over a 6-month period, and then checked for stem pitting by removing the stem bark.

Some Mexican lime receptor plants inoculated with CTV-SY developed CTV symptoms (vein clearing in leaves and stem pitting) and others developed CTV-SY symptoms

(vein corking plus vein clearing and stem pitting). Buds of these Mexican lime plants were grafted on a Pineapple sweet orange, to index for stem pitting and verify virus strain segregation.

RESULTS

The results of transmission experiments are shown in table 1. The T-300 isolate of CTV was transmitted by *A. gossypii* with high efficiency (90%) and by *A. citricola* with lower efficiency (20%). Symptoms were similar on receptor and donor plants.

The T-387 isolate of CTV-SY was poorly transmitted (10%) by *A. citricola* to a plant that developed vein corking in leaf. It was transmitted by *A. gossypii* to three lime plants (30%) which did not develop vein corking, and did not index positive for stem pitting on sweet orange, and to three lime plants (30%) which developed vein corking, and indexed positively for stem pitting on sweet orange.

DISCUSSION

There is an acceptable correlation between results of aphid transmission efficiency for the Spanish T-300 isolate of CTV obtained in this work and in previous work (3): 90 and 78%, respectively for *A. gossypii*; 20 and 6% for *A. citricola*; 0 and 6% for *T. aurantii*; and 0% in both cases for *M. persicae*.

The T-387 isolate of CTV-SY was transmitted by *A. citricola* in this

study even more poorly (10%) than the T-300 isolate of CTV (20%). Nevertheless, this is the most abundant aphid species in Spanish citrus areas (5), and it is potentially responsible for natural spread of this disease in the field.

A. gossypii transmitted the T-387 CTV-SY isolate with higher efficiency (60%) than the other aphid species, but this efficiency was lower than that for the T-300 CTV isolate (90%). *A. gossypii* also transmitted a severe Spanish CTV isolate in previous work with lower efficiency than T-300 (3). In Israel, this aphid species transmitted one CTV-SY isolate poorly, and another CTV-SY isolate with markedly high transmission efficiency (2). In California (7), *A. gossypii* generally transmitted CTV-SY more efficiently than CTV, but there were some exceptions depending on donor or receptor citrus species; CTV was more frequently transmitted from sweet orange to lemon than CTV-SY, but from sweet orange to Mexican lime all the isolates were transmitted with about 100% efficiency. All of these results suggest that there is not necessarily a direct relation between severity and transmissibility of tristeza by aphids.

When the T-387 isolate of CTV-SY was transmitted by *A. gossypii* in this work, some receptor plants (30%) developed only CTV symptoms, and others (30%) developed CTV-SY symptoms. This strain segregation is in agreement with results obtained in

TABLE 1
TRANSMISSION OF CTV AND CTV-SY ISOLATES BY APHIDS IN SPAIN

Aphids species	T-300 isolate of CTV		T-387 isolate of CTV-SY			
	Receptor plants with CTV symptoms		Receptor plants with CTV symptoms		Receptor plants with CTV-SY symptoms	
	No. ^z	%	No. ^z	%	No. ^z	%
<i>Aphis citricola</i>	2	20	0	0	1	10
<i>Toxoptera aurantii</i>	0	0	0	0	0	0
<i>Myzua persicae</i>	0	0	0	0	0	0
<i>Aphis gossypii</i>	9	90	3	30	3	30

^z10 receptor plants per virus isolate and aphid species were inoculated.

other countries (6, 7), where loss of severity was also obtained when transmitting CTV-SY by aphids. These weakened strains have been used for cross protection against the original severe strain.

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