

Threats to Texas Citrus from Exotic Vector-Borne Diseases

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ABSTRACT. A number of arthropod pests of citrus which are also vectors of disease pathogens are present in Texas, but the pathogens are currently not present. Three species of false spider mite, *Brevipalpus phoenicis* (Geijskes), *B. californicus* (Banks) and *B. obovatus* Donnadieu, are the vectors of citrus leprosis virus and have been present in Texas for many years. The glassy-winged sharpshooter, *Homalodisca coagulata* (Say), a vector of the citrus variegated chlorosis (CVC) bacterium, *Xylella fastidiosa*, is native to the area. The Asian citrus psylla, *Diaphorina citri* Kuwayama, the vector of Asian huanglongbing (HLB) or greening disease, is a recent introduction having first been reported in 2001. Leprosis and CVC are widespread in Brazil, have now been reported in Central America, and HLB has recently been found in Brazil. All therefore pose serious threats to the citrus industries of Texas and other states. The threat posed by *Citrus tristeza virus* (CTV) is different in that the virus is already present, but native aphid species are inefficient vectors. However, the brown citrus aphid, *Toxoptera citricida* (Kirkaldy), the effective vector of CTV is in Florida and Mexico and could arrive in Texas at any time.

Citrus in Texas has not, thus far, suffered from any losses caused by any insect- or mite-transmitted diseases. This is due to the absence of most of these pathogens, but several of the vectors are present and the appearance of the pathogens in nearby countries poses a serious threat to future citrus production in Texas.

Citrus leprosis virus (CiLV) is transmitted by three species of the false spider mite (FSM), *Brevipalpus phoenicis* (Geijskes), *B. californicus* (Banks) and *B. obovatus* Donnadieu (2). *Brevipalpus* spp. have been present in Texas for some years (6) causing necrotic lesions on twigs, leaves and fruit mainly in the interior tree canopy of both grapefruit and oranges (3). Fruit lesions first appear as yellowish circular areas on the fruit surface which develop a central brown necrotic area or spot. The brown spots become raised and corky, and often coalesce to cover large areas of the fruit surface, seriously affecting marketability of the fruit. Transmission electron microscopy (TEM) examination of tissue samples from grapefruit and

oranges with “leprosis-like” symptoms collected from Texas citrus orchards failed to reveal any virus particles or viroplasm inclusion bodies (3). It was concluded that CiLV currently does not occur in Texas and that the observed injury is due to feeding of heavy FSM infestations. The recent confirmation of CiLV in Panama (18), Costa Rica (14) and Guatemala (17) is of concern to Texas, since the introduction of the virus into the state which already has high populations of FSM would lead to a rapid appearance and spread of the disease.

Citrus variegated chlorosis (CVC) is caused by the xylem-limited bacterium *Xylella fastidiosum* and is transmitted by several species of sharpshooters. It has been causing serious losses in Brazil since its first appearance there in 1987 (13). CVC has more recently been reported in Costa Rica (1), and also now poses a threat to Texas since one of the insect vector species, the glassy-winged sharpshooter, *Homalodisca coagulata* (Say), is native to the area (8) and is frequently found on native trees and

shrubs such as crape-myrtle (*Lagerstroemia indica*), mesquite (*Prosopis* spp.), and occasionally on dooryard citrus. However, *H. coagulata* is controlled biologically by indigenous wasp parasitoids, *Gonatocerus* spp., that parasitize the eggs (21).

The Asian citrus psylla, *Diaphorina citri* Kuwayama, was reported in Texas in 2001 (9), just 5 yr after it appeared in Florida (12). It is the vector of Asian huanglongbing (HLB or greening), a disease which has caused devastating losses to citrus in Asia (5). *D. citri* has been present in Brazil for several decades, and with the recent discovery and apparent spread of HLB in Brazil (4), all citrus growing regions in the Western Hemisphere need to be concerned.

The situation with *Citrus tristeza virus* (CTV) and the threat to citrus in Texas is different from the cases described above. The virus has been present in Texas for several years (16), but a recent survey showed that while it is more prevalent in east Texas, the incidence in the main commercial citrus growing region of the Lower Rio Grande Val-

ley is very low (19), although some trees carry severe strains (11). Three species of citrus-feeding aphids are present in Texas, namely the melon, or cotton aphid, *Aphis gossypii* Glover, the spirea aphid, *Aphis spiraecola* Patch, and the black citrus aphid, *Toxoptera aurantii* (Fonscolombe). Limited studies in Texas have shown transmission of CTV by *A. spiraecola* (20), but not by *A. gossypii* or *T. aurantii* (7). However, the efficient vector, the brown citrus aphid, *Toxoptera citricida* (Kirkaldy), was reported in Florida in 1995 (10) and in Mexico in 2000 (15). The majority of citrus in south Texas is grown on sour orange rootstock, and the potential arrival of *T. citricida* could result in the transmission of decline-causing CTV strains and the subsequent death of many trees.

The most imminent threats among the aforementioned diseases are leprosis and tristeza, although the appearance of HLB in Brazil increases the likelihood of the introduction of this disease into the United States.

LITERATURE CITED

1. Aguiar, E., W. Villalobos, L. Moreira, C. M. Rodríguez, E. W. Kitajima, and C. Rivera
2005. First report of *Xylella fastidiosa* infecting citrus in Costa Rica. *Plant Dis.* 89: 687.
2. Childers, C. C., J. V. French, and J. C. V. Rodrigues
2003. *Brevipalpus californicus*, *B. obovatus*, *B. phoenicis*, and *B. lewisi* (Acari: Tenuipalpidae): a review of their biology, feeding injury and economic importance. *Exp. Appl. Acarol.* 30: 5-28.
3. Childers, C. C., J. C. V. Rodrigues, K. S. Derrick, D. S. Achor, J. V. French, W. C. Welbourn, R. Ochoa, and E. W. Kitajima
2003. Citrus leprosis and its status in Florida and Texas: past and present. *Exp. Appl. Acarol.* 30: 5-28.
4. Coletta-Filho, H. D., M. L. P. N. Targon, M. A. Takita, J. D. De Negri, J. Pompeu Jr., M. A. Machado, and G. W. Müller
2004. First report of the causal agent of huanglongbing ("*Candidatus Liberibacter asiaticus*") in Brazil. *Plant Dis.* 88: 1382.
5. da Graça, J. V. and L. Korsten
2004. Citrus huanglongbing: Review, present status and future strategies. In: *Diseases of Fruits and Vegetables, Vol. I*, S. A. M. H. Naqvi (ed.), 229-245. Kluwer Academic Publishers, Dordrecht.
6. Dean, H. A. and N. P. Maxwell
1967. Spotting of grapefruit as associated with false spider mites. *J. Rio Grande Valley Hort. Soc.* 21: 35-45.
7. Dean, H. A. and E. O. Olson
1956. Preliminary studies to determine possibility of insect transmission of tristeza in Texas. *J. Rio Grande Valley Hort. Soc.* 10: 25-30.
8. de León, J. H., W. A. Jones, and D. J. W. Morgan
2004. Population genetic structure of *Homoladisca coagulata* (Homoptera: Cicadelli-

- dae), the vector of the bacterium *Xylella fastidiosa* causing Pierce's disease in grapevines. *Ann. Entomol. Soc. Amer.* 97: 809-818.
9. French, J. V., C. J. Kahlke, and J. V. da Graça
2001. First record of the Asian citrus psylla, *Diaphorina citri* Kuwayama (Homoptera: Psyllidae), in Texas. *Subtrop. Plant Sci.* 53: 14-15.
 10. Hardy, N.
1995. Brown citrus aphid found in Ft. Lauderdale. *Citrus Ind.* 76(12): 31.
 11. Herron, C. M., T. E. Mirkov, N. Solís-Gracia, C. J. Kahlke, M. Skaria, and J. V. da Graça
2005. The severity of *Citrus tristeza virus* isolates from Texas. *Plant Dis.* 89: 575-580.
 12. Knapp, J. L., S. Halbert, R. Lee, M. Hoy, R. Clark, and M. Kesinger
1998. The Asian citrus psyllid and citrus greening disease. *Citrus Ind.* 79(10): 28-29.
 13. Lee, R. F., K. S. Derrick, M. J. G. Beretta, C. M. Chagas, and V. Rossetti
1991. Citrus variegated chlorosis: a new destructive disease of citrus in Brazil. *Citrus Ind.* 72(10): 12-13, 15.
 14. Locali, C. R., J. Freitas-Astua, A. A. de Souza, M. A. Takita, G. Astua-Monge, R. Antonioli, and E. W. Kitajima
2003. Development of a molecular tool for the diagnosis of leprosis, a major threat to other citrus production in the Americas. *Plant Dis.* 87: 1317-1321.
 15. Michaud, J. P. and R. Alvarez
2000. First collection of brown citrus aphid in Quintana Roo, Mexico. *Fla. Entomol.* 83: 357-358.
 16. Olson, E. O. and B. Sleeth
1954. Tristeza virus carried by some Meyer lemon trees in south Texas. *J. Rio Grande Valley Hort. Soc.* 8: 84-88.
 17. Palmieri, M., I. Donis, A. L. Salazar, S. Blanco, M. Porres, R. H. Brlansky, A. S. Guerrero-Moreno, K. L. Manjunath, and R. F. Lee
2005. Leprosis in Guatemala. In: *Proc. 16th Conf. IOCV*, 386-391. IOCV, Riverside CA.
 18. Saavedra de Dominguez, F., A. Bernal, C. C. Childers, and E. W. Kitajima
2001. First report of citrus leprosis virus in Panama. *Plant Dis.* 85: 228.
 19. Solís-Gracia, N., C. J. Kahlke, C. M. Herron, J. V. da Graça, K. L. Esau, H. Q. Miao and M. Skaria
2001. Surveys for *Citrus tristeza virus* in Texas 1991-2000. *Subtrop. Plant Sci.* 53: 4-8.
 20. Smith, G. S. and C. J. Farrald
1988. Experimental transmission of citrus tristeza virus by a Texas population of *Aphis citricola* from Marrs orange. *J. Rio Grande Valley Hort. Soc.* 41: 111-114.
 21. Triapitsyn, S. V., R. F. Mizell III, J. L. Bossart, and C. E. Carlton
1998. Egg parasitoids of *Homalodisca coagulata* (Homoptera: Cicadellidae). *Fla. Entomol.* 81: 241-243.