Imperial County Agricultural Briefs

Features

From your Farm Advisors

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Cultural Practices Key to Management of Whitefly-Transmitted Virus Diseases

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In the late 1920's, sweetpotato whitefly *Bemisia tabaci* (Gennadius) was first reported as a pest on southern California cotton and whitefly-transmitted virus disease problems have affected many crops since. Cotton leaf crumple (CLCr) disease, caused by *Cotton leaf crumple virus* (CLCrV), was the first serious whitefly-transmitted disease problem associated with *B. tabaci* in southern California and was reported in 1954. This disease outbreak was effectively managed by two control methods. The first method was regulatory control requiring elimination of ratoon cotton (cotton grown as a perennial). The second cultural control method, "sanitation," was physical elimination of ratoon cotton and volunteer cotton from scattered seed around fields and ditch banks by shredding, discing, and rogueing. In 1981 CLCr disease again became an economic problem in southeastern California and Arizona with a severe outbreak of sweetpotato whitefly; now referred to as sweetpotato whitefly Biotype A or *B. tabaci* Biotype A, and again in the 1990's with the invasion of *B. tabaci* Biotype B also known as the silverleaf whitefly, *B. argentifolii* (Bellow and Perring). Currently CLCrD is not a major problem because of the limited production of cotton in the Imperial Valley.

Sweetpotato whitefly Biotype A was responsible for several other virus disease outbreaks during the late 1970's and early 1980's. Squash leaf curl (SLC) disease caused by the, *Squash leaf curl virus* (SLCV), was first reported infecting cucurbits in 1978. SLC disease severely reduced spring and fall production of zucchini and other summer-type squashes grown in southern California. The virus does not cause disease in melons or watermelons. The SLC disease contributed to the eventual elimination of banana squash, pumpkins, and other types of winter squashes grown during the summer months in southeastern California. Another disease contributing to the demise of squash production in the Imperial Valley was lettuce infectious yellows (LIY) caused by *B. tabaci*-transmitted *Lettuce infectious yellows virus* (LIYV). LIYV infects squashes and melons, including watermelon, and it caused economic losses in the 1980s. Because LIYV is not transmitted by *B. tabaci* Biotype B, it basically disappeared after the displacement of *B. tabaci* Biotype A by *B. tabaci* Biotype B in the early 1990s. Also during the early-1990's, a disease called tomato necrotic dwarf eliminated the fall production of tomatoes grown for planting seed in southeastern California. This disease was thought to be caused by a whitefly-transmitted virus (tentatively name Tomato necrotic dwarf virus), but the virus has yet to be well-characterized.

The lack of implementation of adequate regulatory and cultural control methods to supplement the use of then newly registered whitefly control insecticides made it difficult, if not impossible, to effectively manage levels of whitefly and virus disease in a number of crops in the Imperial Valley in the 1980's and 1990's. The near continuous production of cucutbit crops, large populations of volunteer melons during summer months following spring melon crops, the production of whitefly host bridge crops such as cotton, and the difficulty and high costs of summertime sanitation practices were all contributing factors working against efforts to successfully implement cultural management as part of an overall whitefly and virus disease IPM program.

Lettuce chlorosis (LC) disease, caused by *Lettuce chlorosis virus* (LCV), is another sweetpotato whitefly Biotype B-transmitted virus. It was first detected in fecting lettuce crops in the mid-1990's. LC disease was of little concern until the 2005/06 lettuce production season in southeastern California when there was severe damage to leaf lettuce types, especially Romaine. Little has been done to manage LC through cultural practices because it rarely causes severe economic losses.

During the 1998 fall melon production season, a new cucurbit virus disease, cucurbit leaf crumple (CuLCr), was discovered in the Imperial Valley. CuLCr disease is caused by the sweetpotato whitefly Biotype B-transmitted begomovirus (begomoviruses are whitefly-transmitted geminiviruses), *Cucurbit leaf crumple virus* (CuLCrV). This virus was identified and characterized in Robert Gilbertson's laboratory at UC Davis. CuLCr causes serious economic losses in squash production, but not in melon or watermelon production because plants recover from initial infections and produce acceptable yields. There has been little or no economic incentive for growers to implement cultural controls to protect the relatively small acreages of squash from whitefly-transmitted viruses. Rather, growers have essentially stopped producing squashes in the Imperial Valley.

Most recently, two new sweetpotato whitefly Biotype B–transmitted virus diseases have recently appeared in southern California. The first problem became apparent in the fall of 2006: cucurbit yellow stunting disorder (CYSD) disease caused by *Cucurbit yellow stunting disorder virus* (CYSDV), an exotic *Crinivirus*. This virus infects most types of cucubits, including melons and watermelons, and has caused considerable economic damage in the Imperial Valley and Yuma, Arizona to melon crops. Several meetings to discuss CYSDV and its management were organized by UA Cooperative Extension and UC Cooperative Extension and include, melon growers, pest control advisors, and others. Although a cucurbit-free period along with extensive sanitation efforts were suggested, there was little interest among Imperial Valley growers to participate in a voluntary melon free period program to try and break the disease cycle of CYSD in southern California. However, Arizona growers implemented the voluntary melon free period with some success, and continue to grow fall melons. Although William Wintermantel, USDA ARS in Salinas, CA and Eric Natwick, UCCE, Imperial County identified several annual and perennial CYSDV host plants that bridge the gap of between spring and fall melon production perpetuating the CYSD cycle, we still recommend compliance with a voluntary melon free period to reduce the buildup of *B. tabaci* Biotype B population levels and CYSDV during the summer months to help reduce the potential of CYSDV transmission to fall cucurbit crops.

The second new virus disease identified in the Imperial Valley was tomato yellow leaf curl (TYLC) caused by the begomovirus *Tomato yellow leaf curl virus* (TYLCV). This exotic virus is the most recent whitefly-transmitted virus disease to appear in California and Arizona. It is one of the most damaging viruses of tomato and causes substantial economic losses to tomato production worldwide. Dr. Robert Gilbertson, Department of Plant Pathology, UC Davis, identified TYLCV in tomato samples collected by Eric Natwick from a noncommercial greenhouse in Brawley, CA in March 2007. Because TYLCV posed a threat to commercial tomato production statewide as well as production of pepper and tomato transplants in southeastern California, CDFA and the Imperial County Agricultural Commissioner implemented surveys to detect the incidence and spread of TYLCV. There was an eradication effort in Imperial County coordinated between CDFA and the Imperial County Agricultural Commissioner's Office, but TYLCV was subsequently found in the Coachella Valley in Riverside County, CA in 2008. Through surveys of commercial tomato fields, TYLCV has been detected by Natwick and Gilbertson in commercial tomato fields in Imperial County each year after the initial find in Brawley, CA. However, the tomato and pepper transplant industry in Imperial County has remained free of TYLCV, presumably because production occurs when whiteflies are absent or at low populations, and TYLCV has not been found elsewhere in California. TYLCV has a moderate host range including members of plant families including Solanaceae (tomato, peppers, various weeds, and ornamentals), Malvaceae (cheeseweed), and Fabaceae (beans). However, tomato is the host to which the virus is best adapted and that is most important to disease epidemiology. Therefore the disease can be managed through tomato-free periods and sanitation, whitefly management (cultural and chemical) and resistant varieties. Because tomato production is limited in the Imperial Valley, it does not appear that TYLCV that the incidence of TYLCV is increasing.

Current Status and Management Efforts for the Introduced TYLCV in California

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Tomato yellow leaf curl virus (TYLCV) a whitefly-transmitted geminivirus (also known as begomoviruses) that is one of the most damaging viruses known to infect tomatoes. TYLCV causes the tomato yellow leaf curl (TYLC) disease, which is characterized by stunted growth and leaf yellowing and curling; this disease can cause 100% losses in tomato fields. Originally a virus found only in Old World locations (e.g., the Mediterranean basin, Asia and Africa), it was inadvertently introduced into the New World in the early 1990s and it has since spread throughout the Caribbean basin, the southeastern United States and Mexico). More recently, the virus also has been found in Arizona, Hawaii and the Rio Grande Valley of Texas. In March 2007, TYLCV was first detected in California from tomato plants showing TYLC-like symptoms collected by Eric Natwick from a noncommercial greenhouse in Brawley, California. Dr. Robert Gilbertson, Department of Plant Pathology, UC Davis, confirmed the presence of TYLCV in these diseased tomatoes. Because TYLCV posed a threat to commercial tomato production statewide, CDFA and the Imperial County Agricultural Commissioner initiated efforts to contain and eradicate TYLCV in Imperial County. However, by the fall of 2008, TYLCV was found in the Coachella Valley in Riverside County, CA. Since 2008, annual surveys of commercial tomato fields in Imperial Valley have revealed TYLCV-infected plants, albeit at relatively low incidences in most fields. However, TYLCV has not been detected in tomato and pepper transplants produced in Imperial County, nor has TYLCV been found elsewhere in California. This is very important because growers throughout California obtain tomato and pepper transplants produced in Imperial County and Yuma, Arizona. Thus, efforts have been made to monitor these transplants for whiteflies and TYLCV. To date, TYLCV has not been found in any of these transplants, due to the diligence of the transplant growers in California to maintain clean culture via sanitation practices, and the fact that populations of whiteflies are low or non-existent during the time that transplants are produced. Consistent with the results of these surveys, TYLCV has not been found in the major tomato growing areas of California, including fields established with transplants from Imperial County and Yuma. Thus, although TYLCV has not been eliminated from California, the combined efforts of CDFA, UC Cooperative Extension, UC Davis, Imperial County Agricultural Commissioner's Office, the tomato transplant industry in southern California, the California Tomato Research Institute (CTRI) and the California League of Food Processors (CLFP) have provided information to growers about the disease, supported extensive surveys for TYLCV spread and helped contain the virus to the Imperial Valley and Coachella Valley.

However, growers, transplant producers, PCAs and others associated with the tomato industry need to be looking for symptoms of TYLCV. Typical symptoms of TYLC disease in tomato are stunted and unusually erect upright growth and yellow (chlorotic) leaf edges and interveinal areas, upward leaf cupping and crumpling, reduced leaf size, and flower drop. TYLCV can have a severe impact on tomato production. Plants infected at early stages of growth (before flowering) won't bear fruit, and growth will be severely stunted. However, TYLCV cannot be identified based only on symptoms, because other viruses can cause TYLC-like symptoms, such as *Alfalfa mosaic virus*, curly top viruses and *Tomato mosaic virus*. Therefore, crop or weed plants suspected of having TYLCV infection can be brought to a UC Cooperative Extension Office in your county or your local Agricultural Commissioner's Office and they will be shipped to Dr. Robert Gilbertson at UCD or to CDFA to confirm the presence of TYLCV.

An effective IPM program for TYLCV has been developed in areas where the virus in endemic, and this program involves tomato-free periods, planting disease-free transplants and resistant varieties, whitefly

management and extensive sanitation. However, it is important to emphasize that there are a number of factors **that do not favor establishment of the virus in the major tomato-producing areas of California**. First, *Bemisia* whiteflies are not typically found in these tomato-producing areas because the insect is intolerant of the cold winter temperatures in these locations (e.g., Colusa, Fresno, Kings, Merced, San Joaquin and Yolo Counties). Second, the winter season provides a "natural" tomato-free period, usually from late November through early February. This break eliminates the primary host of the virus, which is tomato. TYLCV can infect other crops such as beans and peppers, but it does so less efficiently (e.g., many types of beans and peppers show no symptoms when infected with the virus). Even if the virus were able to overwinter in other (weed) hosts, it does so inefficiently, resulting in delayed appearance of the virus and less economic damage to tomato crops. However, in areas subject to high whitefly populations, such as Imperial Valley and Riverside Counties, late-planted tomatoes are likely to be impacted by TYLCV.

Therefore, based upon our knowledge of TYLCV in California to date, the following procedures are recommended for management of TYLC disease:

1) Produce and plant virus- and whitefly-free tomato and pepper transplants. Transplants should be treated with Capture (bifenthrin) or Venom (dinotefuran) for whitefly adults and Oberon for eggs and nymphs. Imidacloprid or thiamethoxam should be used in transplant houses at least 7 days before shipping. Transplants should be produced in areas well away from tomato and pepper production fields. Surveys of transplants and fields for whiteflies and TYLC-like symptoms are highly recommended, with any plants suspected of being infected with TYLCV testedby UCD or CDFA.

2) Use a neonicotinoid insecticide, such as dinotefuran (Venom) imidacloprid (AdmirePro, Alias, Nuprid, Widow, and others) or thiamethoxam (Platinum), as a soil application or through the drip irrigation system at the time of transplanting of tomatoes or peppers. After the efficacy of the neonicotinoid insecticide application begins to decline, the secondary spread of whiteflies will need to be controlled. Monitor whitefly populations throughout the season, treating when present. Rotate insecticide classes for insecticide resistance management (IRM). Foliar insecticide treatments used in IRM for whitefly control include: Capture, a pyrethroid; foliar neonicotinoid insecticides dinotefuran (Venom), imidacloprid (Provado), and thiamethoxam (Actara), but do not use if a neonicotinoid insecticide was applied as a soil or drip irrigation treatment; insect growth regulators such as pyriproxyfen (Knack) and buprofezin (Courier); insecticidal soap; and crop oils. A highly UV-reflective mulches (metalized) and low rates of crop oil (0.25 -0.50 percent) can also be used as whitefly repellents to reduce whitefly feeding and virus transmission.

3) Sanitation is very important for preventing the migration of whitefly adults and the spread of TYLCV. Rogue tomato plants with early symptoms of TYLCV from fields by placing infected-looking plants in plastic bags immediately at the beginning season, especially during first 3-4 weeks. Maintain good weed control in the field and surrounding areas. Prevent the spread of any whiteflies to healthy plants. After harvest of tomato and pepper fields, plants should be promptly destroyed by deep plowing or some other method. Also destroy old harvested plants and volunteers of melons and cotton immediately after harvest to reduce whitefly migration to tomatoes.

CIMIS REPORT AND UC DROUGHT MANAGEMENT PUBLICATIONS

Khaled Bali and Sharon Sparks*

California Irrigation Management Information System (CIMIS) is a statewide network operated by California Department of Water Resources. Estimates of the daily reference evapotranspiration (ET_o) for the period of June 1 to August 31 for three locations in the Imperial County are presented in Table 1. ET of a particular crop can be estimated by multiplying ET_o by crop coefficients. For more information about ET and crop coefficients, contact the UC Imperial County Cooperative Extension Office (352-9474) or the IID, Ag Water Science Unit (339-9082). Please feel free to call us if you need additional weather information, or check the latest weather data on the worldwide web (visit http://tmdl.ucdavis.edu and click on the CIMIS link).

Table 1.Estimates of daily Evapotranspiration (ET_o) in inches per day

Station	June		July		August	
	1-15	16-30	1-15	15-31	1-15	16-31
Calipatria	0.39	0.40	0.39	0.38	0.35	0.32
El Centro (Seeley)	0.36	0.38	0.38	0.37	0.32	0.29
Holtville (Meloland)	0.38	0.39	0.39	0.38	0.34	0.31

* Irrigation Management Unit, Imperial Irrigation District.

Link to UC Drought Management Publications

http://ucmanagedrought.ucdavis.edu/