



Features from your Advisors

February 2016

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A HISTORY OF CURLY TOP DISEASE MANAGEMENT

Eric T. Natwick, Entomology Advisor, UCCE Imperial County

During the late 19th century, some agricultural scientists first began to recognize that some plant diseases are caused by viruses and later still that some of the plant viruses causing disease are transmitted by insects. Among the first plant viral diseases to be recognized was curly top disease caused by any of three viruses in the genus Curtovirus (family Geminiviridae). The viruses that cause curly top disease are *Beet mild curly top virus* (BMCTV), *Beet severe curly top virus* (BSCTV) and *Beet curly top virus* (BCTV). All three curly top viruses have a broad host range of over 300 plant species in 44 plant families and they infect several economically important crops including beans, beet (sugar and table), cucurbits (cucumber, melon, pumpkin, squash), flax, pepper, spinach, and Swiss chard. The beet leafhopper (BLH), *Circulifer tenellus* was later shown to be the vector of the curly top disease viruses cause. Curly top disease is reported throughout western North America. During the 1880's - 1900, there were reports of disease in garden beets in Nebraska, of a devastating loss of sugar beets in Lehi, Utah and reports of a new disease negatively affecting the newly emerging California sugar beet industry. In 1915, the relationship between the BLH and curly top disease was strongly suggested by transmission studies. The BLH can transmit all three curly top viruses simultaneously. However, it was not until 1974, through advances in virus purification and electron microscopy, that a virus was formally proven to be the cause of the curly top disease.

The BLH also has a broad host range including many wild plant species, crop species and weeds. The insect has three or more generations per year depending on the climate and the winged adult BLH can be moved long distances by wind currents. Using piercing-sucking type mouth parts, the BLH can cause direct feeding injury to plants by injecting salivary fluids and removing plant sap, but the feeding causes relatively minor damage that is rarely, if ever, of economic importance. The pest status of BLH is elevated due to transmission of the viruses causing beet curly top disease; a disease that can be extremely destructive to sugar beet and many vegetable crops grown in California. Therefore, monitoring and management of this pest is essential for production of crops susceptible to curly top disease.

Virus acquisition occurs quickly when BLHs feed on curly top infected plants, but the most efficient transmission occurs after a 48-hour acquisition period. Beet leafhoppers can remain viruliferous for more than 3 months. Beets infected during early plant development often die quickly. Foliar symptoms of curly top infection of more mature plants include: leaf yellowing and death of older leaves; newer leaves remain small and are numerous compared to a healthy plant; leaves roll upward and inward; and blister-like veins swelling on the underside of leaf resemble galls. Root symptoms include: necrosis of periderm and phloem cells adjacent to sieve tubes, dark concentric rings when the taproot is bisected in cross section or dark streak when bisected longitudinally.

Two types of management for curly top disease and its vector, beet leafhopper, are local and area wide management. Local management by individual growers of susceptible curly top crops starts with sanitation, including immediate destruction of crop residues following harvest of susceptible crops that can harbor the beet leafhopper or the viruses that cause curly top disease. Before direct seeding or transplanting a susceptible crop, to reduce sources of beet curly top disease inoculum, it is essential to remove weed hosts and volunteer crop plants such as sugar beet from around a vegetable or sugar beet field. Curly top disease resistant sugar beet varieties were first developed in the 1930's and resistant varieties are still used in some growing areas today. Insecticide applications play a minimum role in management of curly top at the local field level because foliar insecticides applied directly to vegetable crops or sugar beets are not effective for beet leafhopper management or for reduction of beet curly top disease incidence. Soil applied systemic insecticides such as Thimet 20G have occasionally proven valuable in reducing the incidence of beet curly top disease in areas where infections can occur early in the crop cycle. The efficacy of soil systemic insecticide treatments depends on 1) climatic factors affecting beet leafhopper and virus weed hosts, 2) timing of planting and application of materials relative to leafhopper migration and 3) proximity of the susceptible crop fields to leafhopper and virus overwintering sites.

Area wide insecticide programs to control beet leafhoppers on overwintering weed hosts is a proven, efficacious and economical management strategy for beet leafhopper and curly top disease. This is the primary method for managing beet leafhopper and curly top disease for both the sugar beet industry in the western U.S. and more importantly in the California vegetable crop industry. In area wide curly top disease management programs, the beet leafhopper population is monitored and managed in weedy overwintering areas before the weed hosts dry down. The BLH population is treated with an insecticide and in some areas, the BLH weed host plants are controlled with herbicides. When the weed hosts begin to dry up and die, the leafhopper adults migrate to crop hosts if not managed with insecticide spray applications and when viruliferous, they can spread curly top disease.

In recent years when there were lapses in the vector management in the overwintering sites of the beet leafhopper along the foothills of the Sierra Nevada mountain range outbreaks of curly top disease problems then occurred in the tomatoes and melons grown in the California Central Valley areas. Although the viruses that cause beet curly top disease and the beet leafhopper are endemic to the Imperial Valley, the Imperial Valley sugar beet crop is rarely economically affected by beet curly top. However, during the 2013/2014 sugar beet production season, beet curly top broadly and negatively affected the Imperial Valley sugar beet crop.

The recent outbreaks of curly top disease problems throughout California renewed interest among vegetable crop growers, beet growers and the CDFA to support a statewide research project. The research project is funded by the California Tomato Research Institute (CTRI) and the CDFA; Dr. Robert Gilbertson, a UC Davis Plant Pathology Professor, is the project leader. Our team is conducting research that involves gaining a better understanding of the epidemiology of curly top disease. Part of the research involves a statewide monitoring survey of the viruses that cause curly top and the beet leafhopper on crops, weeds and wild native host plants.

The survey coupled with other research from Robert Gilbertson Laboratory at UC Davis will provide a better understanding of the epidemiology of curly top disease. This in turn will aid in the development of guidelines for growers, PCAs and government agencies to better prevention and management of curly top disease problems in vegetable crop and sugar beet production areas throughout California.

NOTES ON CARROT DISEASES IN THE COACHELLA VALLEY

Jose Luis Aguiar, Advisor, UCCE Riverside County

Cottony Soft Rot of Carrots

Cottony soft rot is caused by *Sclerotinia sclerotiorum*. *S. Sclerotiorum* is also called white mold on many other vegetable crops. Cottony soft rot is common wherever umbelliferous crops are grown and it can infect celery, anise, caraway, chervil, dill, parsley and parsnips. *S. Sclerotiorum* can be a problem in field production when soil temperatures are 55° to 86°F. This pathogen can also be a postharvest problem.

Cottony soft rot can be confused with crater rot, caused by *Rhizoctonia carotae*. The white, fluffy mycelia fungal mats of cottony rot are absent in crater rot. On carrots, the cottony soft rot begins as small water soaked lesions on the crowns and roots. The mycelial fungal mat will develop on the affected tissue leading to a softening and decaying of the tissue. Sclerotia will develop in these areas.

Cultural practices can contribute to control the development of cottony soft rot of carrots. Sprinkler irrigation is the common method for irrigating carrot fields in the Coachella Valley. However, when the weather cools, the soil stays damp for extended periods creating conditions favorable for disease development. After the carrot crop is harvested, deep plowing should be practiced in soils with *Sclerotinia* diseases. Rotations to non-host crops such as small grains would also help. *Sclerotinia* spp, resistance is not available in carrots.



Figure 1. *Sclerotinia sclerotiorum*; cottony soft rot on carrots.



Figure 2. Cottony soft rot on carrots leading to tissue decay.

Bacterial Leaf Blight of Carrots

Bacterial leaf blight of carrots is caused by *Xanthomonas campestris* pv *carotae*. This bacterial disease can be a problem in densely planted fields that have high levels of rainfall or where sprinkler irrigation is used to grow the crop. Given the usually dry conditions in the desert, bacterial leaf blight is a rare problem in the Coachella Valley. This disease begins on the leaves as small, yellow spots that in a few days expand, turn brown and become water-soaked lesions. These lesions are surrounded by a yellowish halo. Severe outbreaks of bacterial leaf blight can result in yield losses.

Bacterial leaf blight of carrots can be seed borne. There is a seed treatment for this disease. This disease can also be spread in the field by splashing water, via insects, animals and farm machinery. This pathogen can also persist in carrot debris in the soil. Frequent rain and sprinkler irrigation, as well as high humidity and dew favor this disease. Optimum temperature for disease development is 77° and 86°F. There are materials registered for foliar applications for the control of this disease. But only rarely does this disease warrant control measures. The use of furrow or drip irrigation can help reduce the incidence of bacterial leaf blight.



Figure 3. Bacterial Leaf Blight of Carrots.



Figure 4. Bacterial Leaf Blight causing brown discoloration of the foliage.

***Thanatephorus cucumeris* On Carrots**

Rhizoctonia solani is a fungus that causes diseases on a wide variety of crops. This pathogen persists in crop residue in the soil for a long period of time as sclerotia or mycelium. Cultivation of fields can aid the fungus by pushing the contaminated soil onto the plant foliage and in the plant crown. On celery and parsley this pathogen causes crater spot.

Scientists classify fungi based on the structures produced by sexual reproduction. Fungi that did not have a known sexual stage were classified as Fungi Imperfecti. However, many fungi reproduce asexually and some produce both sexually and asexually creating some confusion in the classification system. Part of the life cycle of *Rhizoctonia solani* is referred to as teleomorph. This is a reference to fungi in the phyla Ascomycota and Basidiomycota. A teleomorph is the sexual reproductive stage (morph) of fungi, which is typically a fruiting body. Also complicating the identification/classification of fungi is the fact that even among fungi that reproduce sexually and asexually (anamorph), usually only one method of reproduction can be observed at one point in time and under very specific conditions. Below are two examples of *Thanatephorus cucumeris* on carrot fields in the

Coachella Valley. *T. cucumeris* is favored by periods of high humidity and cool temperatures. *T. cucumeris* appears as a white mycelia mat that grows on carrot stems near the base. According to plant pathologists, *T. cucumeris* is the perfect stage of *Rhizoctonia solani* and does not cause infections on carrots. The damage caused by these fungi is mostly cosmetic.

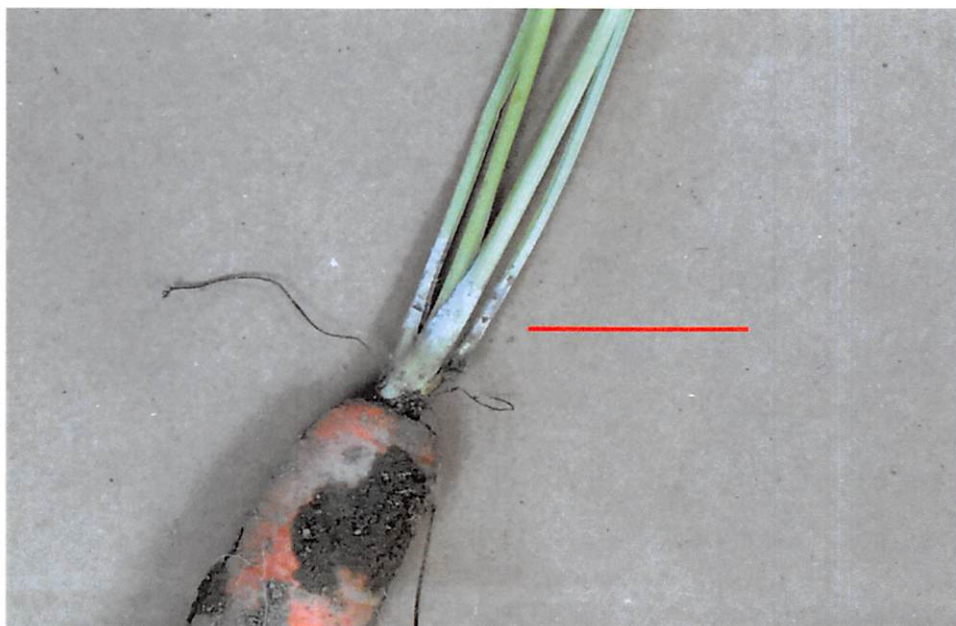


Figure 5. *Thanatephorus cucumeris* on carrots.



Figure 6. *Thanatephorus cucumeris* causing cosmetic damage on the foliage.



Figure 7. Sprinkler irrigation is a common irrigation practice for carrot production.

Special thanks to Steve Koike, UCCE Monterey and Joe Nunez, UCCE Kern County for laboratory analysis of plant diseases.

Save the Date...

April 13, 2016

Agronomic Crops & Water Conservation Field Day

Location: UC Desert Research & Extension Center (DREC)
1004 E Holton Road Holtville, CA 92250

Time: 7:00 AM to 12:00 PM

Presented by the

University of California Cooperative Extension Imperial County

More information to follow regarding the event; topics, agenda, CEU's, etc.

No Cost to Attend!

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THE UNIVERSITY OF ARIZONA

College of Agriculture & Life Sciences

Agricultural & Biosystems Engineering

Automated In-Row Cultivator Technology Field Demos

What: On-farm field demos of robotic in-row weeding technology

Who: Growers interested in evaluating the technology

Where: Yuma and Imperial Valleys

When: Please schedule. Available Spring, 2016 and Fall, 2016- Spring 2017.

About: Through a USDA-NIFA grant, the University of Arizona and UC Davis purchased an automated, in-row cultivator. The unit utilizes a camera-based machine vision to detect crop plants and hydraulically activated knife blades to control in-row weeds. One of the project objectives is to demonstrate the technology to interested growers and obtain feedback. The equipment demonstrated is manufactured in Europe and is commercially available in the U.S.

Video: <https://www.youtube.com/watch?v=3Ua8Y6nNtGw>

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