

# BEET CURLY TOP DISEASE (CURTOVIRUSES) IN SPINACH AND TABLE BEETS IN ARIZONA

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## Introduction

Beet curly top disease is caused by Curtoviruses, a group of viruses transmitted by the beet leafhopper (*Circulifer tenellus*). It occurs in many different plants in Arizona including tomato, pepper, cucurbits, spinach, and beets. The viruses also are differentially hosted by many other plants including alfalfa (Nischwitz and Olsen, 2010) and many weeds (Creamer et al. 1996; Lam et al. 2009). In the USA, the Curtovirus group currently consists of seven viruses – Beet curly top virus (BCTV), Beet mild curly top virus (BMCTV), Beet severe curly top virus (BSCTV), Pepper curly top virus (PCTV), Pepper yellow dwarf virus (PYDV), Spinach curly top virus (SCTV) and Horseradish curly top virus (HrCTV). When more than one of these viruses infects a plant, they readily exchange genes and recombine, so variation in their incidence is common. Curtoviruses and their only known vector, the beet leafhopper, are native to the western United States. In recent years, Curtoviruses have resulted in significant losses in table beet and spinach plantings in Arizona. The Curtoviruses associated with spinach and beets in Arizona during 2009-2010 are identified in this bulletin along with other non-symptomatic hosts that harbor the viruses. Knowledge of host range and location are useful for efficacious weed control and reduction in disease severity.

## Pathogen

Curtoviruses (in Arizona mainly: BSCTV, PCTV and recombinants between PCTV, PYDV and BMCTV). They belong in the family Geminiviridae and consist of one particle of circular single-stranded (ss)DNA.

## Vector

Beet leafhoppers (*Circulifer tenellus*) are wedge-shaped, about 1/8" long and pale green to gray colored (Fig. 1). They belong to the group of plant feeding insects known as "hoppers". Because of their small size and quick movement, they may be difficult to see individually. However, when in large numbers on a host, they are easily detected by shaking the plant.



Figure 1. Beet leafhopper (*Circulifer tenellus*)

## Host

Dicotyledonous plants including spinach, table beets, alfalfa, (*Sisymbrium irio* (Fig.2), *Chenopodium species* (Fig. 3), *Amaranthus species* (Fig 4 and 5), *Fumaria capreolata* (Fig. 6), *Tidestromia lanuginosa* (Fig. 7a and 7b), *Melilotus indicus* (Fig. 8) and *Funastrum hirtellum* (Fig. 9). With the exception of *Fumaria capreolata*, which is a recent introduction to Arizona (The University of Arizona Herbarium), these weed species are commonly found in Arizona. They were all confirmed as Curtovirus hosts in 2009 and 2010.

## What you should know

- Curtoviruses are transmitted only by the beet leafhopper
- Curtoviruses and beet leafhopper are native to the western U.S.
- Good weed control and a delay in fall planting until October or later can reduce disease incidence in spinach and table beets

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Figure 2. *Sisymbrium irio*

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Figure 4. *Amaranthus hybridus*

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Figure 5. *Amaranthus retroflexus*

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Figure 3. *Chenopodium pratericola*

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Figure 6. *Fumaria capreolata*



Figure 7a and b. *Tidestromia lanuginosa*



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Figure 8. *Melilotus indicus*



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Figure 9. *Funastrum hirtellum*



Figure 10. Symptomatic spinach plants in the field



Figure 11. Vascular discoloration of a red beet infected with a Curtovirus (right) compared to healthy beet (left).

### Symptoms

Infected weeds and alfalfa plants are symptomless. Spinach plants are stunted, and their leaves are chlorotic and distorted (Fig. 10). Foliar symptoms in table beets are similar to those in spinach. In infected beets, discoloration of the vascular tissue may be observed in cross sections of the root (Fig. 11).

### Disease

Beet leafhoppers survive in Arizona throughout the year in weeds and field crops. When spinach and beets are planted from September to December, the leafhoppers migrate from drying desert vegetation and weeds to irrigated agricultural fields to feed on young green tissue. Nymphs of beet leafhoppers acquire the virus while feeding on the phloem of infected plants. The virus is ingested and moves from the digestive system to salivary glands. When the leafhoppers feed on a non-infected plant, the virus is injected with saliva into the plant. The virus is transmitted in a persistent manner which means that leafhoppers are able to transmit the virus for the rest of their lives. The virus does not replicate in the leafhopper and is not passed on to the off-spring (Soto and Gilbertson, 2003).

## Prevention/Management

Field observations in Arizona indicate that a delay in planting until late October or November can reduce disease incidence in spinach and table beets. Leafhoppers become less active when daily high temperatures cool below 60F (Hein, 2006), and they remain on their overwintering weed or field crop hosts. Spinach and beet fields are more likely to be targeted during warm temperatures when leafhoppers are migrating longer distances looking for new host plants. Since many weeds are hosts for Curtoviruses, good weed control in the vicinity of spinach and beet fields can drastically reduce disease incidence. Application of insecticides to weeds and field crops that serve as overwintering hosts also has been used to manage beet curly top disease, but is expensive and may not be an economically viable option for many growers. It is currently not known if any spinach or table beet varieties are resistant to Curtoviruses.

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