

Beet Leafhopper and Beet Curly Top Virus

Beet leafhopper, *Neodlitursus* (= *Circulifer*) *tenellus*¹ is an uncommon insect found in hemp fields but can cause serious injury to the crop because of its ability to transmit the virus to plants that produces the disease **beet curly top**². In Colorado beet leafhopper is most common in the West Slope where outbreaks of this disease frequently appear on many crops (e.g., tomato, bean, squash, beets, spinach). Beet leafhopper and beet curly top is also present in eastern Colorado, but is far less common. In 2019, beet curly top infections of hemp were found across the state, but were most severe in the Tri-River counties.

Beet curly top has been observed to produce an extremely wide range of symptoms in hemp. Leaf symptoms may be quite mild, at least during early stages of infection, producing only a slight yellowing/mottling, mostly at the base of a leaf (Fig. 1). Symptoms are often much more dramatic. In some cases whole plants will become pale yellow, often with some slight upward leaf curling, and become generally stunted; these are “classic” symptoms similar to what beet curly top produces in other susceptible crops (Figs. 2a, b).

Other hemp plants may show strong twisting of the new growth, which may remain green or turn yellow. Some stunting also occurs on plants with this symptom (Figs. 3, 4).

Hemp infected with beet curly top virus also has shown some very strange symptoms that appear to be unique to the crop. In some cases, plants that show strong leaf curling appear to



Figure 1. Mild symptom of light yellowing of hemp leaves produced by infection with beet curly top virus



Figures 2a, 2b. Bright yellowing and stunting of the whole plant are “classic” symptoms of beet curly top in hemp.

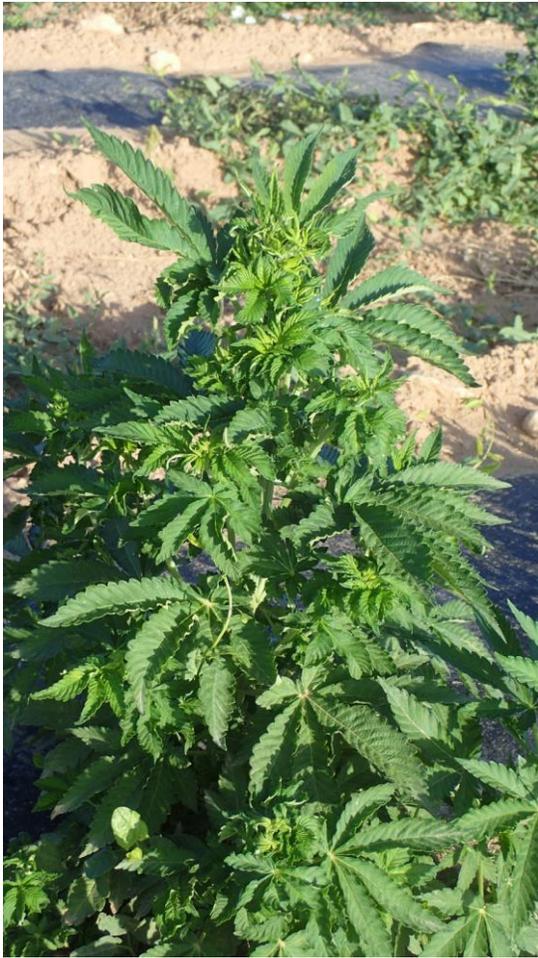


Figure 3. Hemp plant showing twisting of the new growth from beet curly top virus.



Figure 4. Hemp showing a "trifecta" of symptoms, pale mottling of some leaves, twisting of new growth and yellowing.



Figures 5a, b. A "bisymptomatic" hemp plant infected with beet curly top virus. The original main stem has tightly curled new growth (top). Side branches that later develop on the plant are largely symptom-free.

be able to later outgrow most of these symptoms. Another peculiarity often observed is that plants may be "bisymptomatic" where some of the plant shows symptoms and other parts do not (Figs. 5a, b). This most commonly occurs when the original stem develops leaf twisting and becomes stunted. Side branches developing off the main stem are then stimulated to grow and these often appear normal. Interestingly, in these plants, beet curly top virus is detectable in both the original main shoot and the side branches that do not show symptoms.

Beet curly top in hemp is poorly studied and was first described from the crop in 2019. The reason for this wide range in symptoms that can appear is unclear but may involve such things as genetic differences in plant response to the virus or differences in the strains of the virus. There are several strains of beet curly top virus.

So far two of these have been detected in Colorado hemp, the Worland (BCTV-Wor) strain and the Colorado (BCTV-CO) strain which have appeared alone and in combination in hemp plants



Figures 6a, b. Top and side views of adult beet leafhopper. Top photo courtesy of G. Oldfield, USDA/Bugwood.org. Lower photo courtesy of A.C. Magyrosky/Bugwood.org

(Figs. 6a, b). Adults are the only stage that would be found in hemp, this insect does not reproduce on the crop.

(Over a dozen other species of leafhoppers have been found present in Colorado hemp fields. Most are likely transients, as is beet leafhopper, and do not breed in hemp. Of the few that do reproduce in hemp, most common is *Ceratagallia uhleri* (Fig. 7), which has some superficial resemblance to beet leafhopper. No significant injury to hemp is produced by any of these other leafhoppers and no other leafhoppers, other than beet leafhopper, are known to transmit any viruses or other pathogens to hemp.)

The presence of beet leafhopper in Colorado during the growing season is largely, if not entirely, dependent on migrations entering the state in spring that originate from southern areas outside the state, particularly New Mexico. During winter the insect is able to survive on various kinds of weedy plants that continue to grow through winter, particularly mustard-family

showing beet curly top symptoms in 2019. Future research on this situation in the upcoming season should provide more clarity as to whether there is more than the two known strains (Worland, Colorado) of the beet curly top virus producing these hemp disorders

Beet curly top virus has only one insect (vector) capable of allowing the virus to be transmitted to plants, the beet leafhopper. All infections of hemp occur when a beet leafhopper that is carrying beet curly top virus (after previously feeding on a BCTV-infected plant of some kind) feeds on a hemp plant. Both BCTV-Wor and BCTV-CO strains have been confirmed in leafhoppers collected from the Western slope (Delta Co).

Beet leafhoppers are fairly similar in size and general coloration of some of the many other leafhoppers found in hemp and difficult to identify. Adults pale green/light yellow with some blotches, with an elongate slightly wedge-shaped body and about 1/8-1/6 inch in length

plants that grow as winter annuals. The abundance of winter host plants in the southern breeding areas (in NM, maybe AZ) could be an important factor in the number of beet leafhoppers that appear in Colorado in spring; in winter 2019 moisture conditions were very favorable in the southern breeding areas to support the plant on which beet leafhopper develops. Many of the migrant beet leafhoppers carry with them beet curly top virus they acquired when earlier feeding on beet curly top infected plants.

Some beet leafhoppers also survive through winter in western Colorado. This could occur where winter annual mustards, such as flixweed and pepperweed, are present and in good condition to support the insects. This would happen most often when winters were mild and moisture was good. Severe, dry winters would reduce the potential of beet leafhopper to overwinter within the state. However, whether any beet leafhoppers do ever survive within the state, it would happen in only localized areas, and their numbers would be dwarfed by the vastly larger numbers of migrants originating from the main winter breeding areas to the south.

During late spring and summer beet leafhopper can be found on a great many plants but will reproduce on only some of these. Russian thistle is the best known weed host for summer breeding by beet leafhopper and where but there are likely many others. Kochia is the plant on which beet leafhopper is most easily found in western Colorado. Regular surveys of kochia patches should allow one to detect when migrations have moved into the region and are the best plant to survey to get a sense on the relative size of beet leafhopper populations from season to season.

In hemp, adults only will be present and these likely spend little time in the crop, feeding some but then moving to more favored food plants. The detection of beet leafhopper is best done by sampling plants with a sweep net.

Beet curly top is a notoriously difficult disease to manage on any crop. Because of the mobility of beet leafhopper and the rapid speed (a couple of hours) which the virus is transmitted, insecticides are ineffective. Reflective surface mulches, which deter beet leafhopper and other



Figure 7. *Ceratagallia uhleri* is the most common leafhopper found in hemp in Colorado and one of the only ones that reproduces on hemp. Although it feeds on the plant this leafhopper produces no significant injuries nor transmits any pathogens to the crop.

insects (e.g., aphids) from landing on plants, may have some value in reducing beet curly top virus spread in hemp.

¹ Order, Hemiptera, Family Cicadellidae

² Family, Geminiviridae; Genus *Curtovirus*

Credits: Dr. Punya Nachappa, and Judith Chiginsky, Colorado State University, did the analyses of hemp plants for beet curly top virus in 2019. Bob Hammon has provided exceptional assistance regarding biology of the beet leafhopper and curly top virus in Western Colorado.