

# Hop Viruses

## Identification and Management

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**H**ops are dioecious flowering plants in the Cannabaceae family and are indigenous to the temperate regions of the Northern Hemisphere. Hop cones are primarily used as a flavoring agent and preservative of beer.

Viruses are the cause of several diseases of hop. **Apple mosaic virus** (ApMV) is a common disease found worldwide. Infection with this virus can have significant impacts on cone weight and alpha-acid content. However, these losses vary significantly by cultivar, location, and season. **Hop mosaic virus** (HpMV), **hop latent virus** (HpLV), and **American hop latent virus** (AHLV), all of the genus *Carlavirus*, are known to infect hop plants and can lead to decreases in cone yield and alpha-acid content.

Two viroids, **hop latent viroid** (HpLVd) and **hop stunt viroid** (HpSVd) have also been found in the United States. Hop latent viroid is asymptomatic on most cultivars. Hop stunt viroid results in alpha-acid reduction and the stunting of plants after several years of infection.



Maturing hop cones in a Wisconsin hop yard



Hop leaves above show mild apple mosaic virus symptoms and leaves on the right show more severe symptoms.



Photo: David Gent, USDA Agricultural Research Service, Bugwood.org

## Symptoms

Symptoms vary depending on the type of virus and the cultivar infected. ApMV induces chlorotic ringspots or oak-leaf line patterns on foliage, though symptomless infections are also common. Of all the viruses of hop, apple mosaic virus is considered to have the greatest impact on yield.



**Yellow speckling of leaves caused by hop stunt viroid** (above and below)  
Photos: David Gent, USDA Agricultural Research Service, Bugwood.org



The Carlaviruses are generally symptomless on most commercially important cultivars of hop. A chlorotic mosaic may be present on cultivars sensitive to HpMV, with lesions often bounded by major leaf veins.

Hop latent viroid is symptomless in most cultivars. Hop stunt viroid manifests in North America with prominent yellow-green leaves among the basal foliage that develops early in the season. Yellow speckling along major leaf veins can be seen in sensitive cultivars. Plant stunting becomes apparent after several years.

## Virus spread

Viruses are most commonly transmitted through vectors, such as insects, or by direct contact with plant material. Apple mosaic virus, however, has no known vectors and is mainly spread by mechanical means such as harvesting, pruning, or root grafting. American hop latent virus, hop latent virus, and hop mosaic virus are transmitted primarily by the damson-hop aphid. HpMV and HpLV have also been shown to be carried by the potato peach aphid and green peach aphid.



**Damson hop aphid adults**

Photo: David Gent, USDA Agricultural Research Service, Bugwood.org

Vegetative propagation of infected material is also a major route of dissemination. Both hop latent viroid and hop stunt viroid are usually introduced into a new planting through such infected propagation material or are spread mechanically.

## Management

Management of all hop viruses is generally focused on prevention. Using propagation material that is virus-free is the most effective way of avoiding viruses in the hop yard, especially if there are no known vectors. The Carlaviruses can be more difficult to control where both virus and insect vector are present. Planting virus-free stock and replacing diseased plants is a good strategy to limit Carlavirus spread. This set of viruses is generally tolerated in hop yards due to the relatively minimal impacts, with the exception of HpMV-sensitive cultivars. Hop latent viroid is typically included in hop certification schemes. If clean stock is not available, thermotherapy can be used to rid the material of HpLV.



As with the other viruses, planting clean material is the best way to manage hop stunt viroid. Aggressive action should be taken if the viroid is confirmed in a planting. Infected plants and as much of the root as possible should be removed, as should plants adjacent to symptomatic plants. This aggressive action is necessary due to the long latent period for the viroid; plants may be infected but asymptomatic, creating a source of inoculum in the hop yard. If enough infection is present, replanting the entire yard with disease-free material may be the best option.

Changes in horticultural practices can also limit the spread of the viroid. Any field activities should be conducted in HpSVd-free hop yards before being conducted in infected yards. This approach will decrease the risk of transfer between yards. Decontamination of equipment between different fields is good practice, as is thorough washing of equipment to remove sap and plant residue. Using chemical (e.g., herbicidal) rather than mechanical means to remove material is also preferable, as mowing or other mechanical methods may transmit the viroid.



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