



National Clean Plant Network for Hop

A Tier 2 Board of the National Clean Plant Network

PO Box 1207 ♦ Moxee, WA 98936 USA
Tel: 509.453.4749 ♦ Fax: 509.457.8561



Practical Aspects of Managing Hop Stunt Viroid

Hop stunt viroid is a sub-viral pathogen that causes a serious disease of hop plants; the pathogen is approximately $\frac{1}{20}$ th the size of a typical virus. Despite its very small size, it can reduce the yield of hop cones by as much as 65% with additional reductions to the percentage of alpha- and beta-acids in the hop cones. The disease spread throughout Japan in the 1950's and 1960's and its presence in North American grown hops was confirmed in 2005.

How to recognize the disease:

When plants are infected with *Hop stunt viroid*, emergence and early growth is delayed in the spring. By mid-summer, the lengths of internodes of infected bines are reduced by one-third, resulting in the stunted appearance of infected plants that struggle to reach the top wire. As the bines mature, the development of laterals is inhibited and cones are borne on the sparse and shortened lateral branches. Most hills are created from multiple rhizomes so it is possible for a single hill to be a mixture of infected and non-infected plants. The non-infected bines tend to be more robust and are more likely to be trained up the string. By mid-season, pale, stunted infected bines will become more abundant at the base of the strings, and may start to climb the string. The severity of symptoms caused by *Hop stunt viroid* is dependent on hop cultivar; although all hop plants can become infected, the aroma varieties appear to develop more severe symptoms.



How can the spread of Hop stunt viroid be controlled?

Propagation from infected plants is the major route by which *Hop stunt viroid* is spread, and the use of planting material certified to be free of *Hop stunt viroid* is the first line of defense against this pathogen. Observable symptoms of infection by *Hop stunt viroid* may appear only three to five growing seasons after mature plants become infected. This delay in obvious symptom development frequently leads to the unknowing propagation and distribution of infected root pieces.

Hop stunt viroid is readily transmitted through mechanical means. Once *Hop stunt viroid* becomes established in a hop planting, it is easily transmitted by workers, cutting tools and equipment during cultural activities such as mowing to set stringing dates, thinning, and mechanical leaf stripping. Mechanical transmission is most likely to occur when sap pressure is high and abundant contaminated sap is forced from cut or wounded surfaces and then contaminate wound sites of neighboring plants. It is also assumed to be transmitted by root grafting. It is unknown if soil cultivation can directly transmit *Hop stunt viroid*, but it may contribute to root grafting.

If a small number of plants are infected, they should be removed promptly with care to remove as much root tissue as possible. Since there is a delay between initial infection and the appearance of symptoms, nearby healthy appearing plants may also be infected. Therefore, plants adjacent to symptomatic plants should also be removed to reduce the likelihood of perpetuating the disease in the hop yard. If possible, plants to

be removed should be treated in late summer with a systemic herbicide, such as glyphosate, to kill roots. Ideally, sites should be allowed to lay fallow for one season so that any remaining rhizomes that produce shoots can be treated with herbicide. If larger areas are affected, soil fumigation may also be helpful in killing infected root pieces that remain after roguing.

The best methods to prevent the spread of *Hop stunt viroid* within a hop planting and between blocks are still under investigation. However, there are some practices that should help minimize spread. The use of contact herbicide to set training dates and remove weak shoots in the spring is preferable to the use of mechanical mowers that may transmit the viroid. Similarly, removing basal vegetation later in the season by chemical rather than mechanical means also reduces the risk of transmission. Thorough washing of farm equipment to remove plant residue and sap should reduce the likelihood of transmission between yards. Treating knives and cutting tools with a disinfectant solution such as 10% bleach solution for 10 minutes may reduce transmission but results have been inconsistent.

Hop stunt viroid can remain infectious in dry plant debris in the field for 3 months, but it is unknown if this contributes significantly to transmission of the viroid in the field. The viroid is destroyed more rapidly if contaminated plant material is incorporated into the soil.

What do I do if I suspect that some of my planting is infected with *Hop stunt viroid*?

If *Hop stunt viroid* is suspected, prompt action should be taken to limit the possibility of introducing the pathogen into additional plantings. This includes disinfection of farm equipment and hand tools, or aggressive washing at the minimum, before moving from one planting to the next. The decision on how many plants to remove depends on economic factors and the risk to neighboring hop yards if the disease is allowed to spread. In Japan, it is recommended that if 10% or more of the bines are infected in a hop planting, then the whole yard should be replanted. If less than 10% of the bines are infected, then localized plant removal around the infection site is an option. Symptoms of *Hop stunt viroid* can resemble many other conditions caused by other pathogens and unfavorable horticultural conditions. Therefore, it is important to have the cause of the symptoms correctly identified so that appropriate action can be taken.

How many plants should I have tested?

A preliminary assessment can be made by visual inspection, but this may not reveal recent infections, and is difficult for some hop varieties. To determine if 10% of the plants are infected in a planting of 880 plants per acre, you could randomly sample 22 plants per acre. If none of the 22 plants are positive for *Hop stunt viroid*, then you would be 90% confident that less than 10% of the plants were infected. If you want to know if 1% of the plants are infected, then you would have to test 202 samples per acre. These sampling protocols would only give you a plus/minus answer, that is, whether the level of infection is at least 10% or at least 1%. If you want to determine the actual percentage of infected plants, the sampling size would be much larger. The sampling process can also be targeted to collect tissue specifically from symptomatic plants and may reduce the costs of determining whether *Hop stunt viroid* is present within an established yard. We can help develop the most appropriate testing protocol for your situation.

For more information about *Hop stunt viroid* disease and testing, contact:

Ken Eastwell at Washington State University, Prosser

Telephone 509-786-9385; Email keastwell@wsu.edu

Cindy Ocamb at Oregon State University, Corvallis

Telephone 541-737-4020; Email ocambc@science.oregonstate.edu

David Gent at USDA-ARS, Corvallis

Telephone 541-738-4167; Email gentd@onid.orst.edu

Dr. Ken Eastwell, Plant Pathologist, WSU-IAREC, Prosser

Dr. Cindy Ocamb, Extension Specialist and Associate Professor, OSU-Corvallis