

# **HpLVd and Beyond in *Cannabis* Abnormal Growth**

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**Cannabis Conference | August 16,2023|**

# HpLVd Overview



*viruses*



*Review*

## Hop Latent Viroid: A Hidden Threat to the Cannabis Industry

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**Abstract:** Hop latent viroid (HLVd) is the biggest concern for cannabis and hop growers worldwide. Although most HLVd-infected plants remain asymptomatic, research on hops has demonstrated a decrease in both the  $\alpha$ -bitter acid and terpene content of hop cones, which affects their economic value. The HLVd-associated “dudding” or “duds” disease of cannabis was first reported in 2019 in California. Since then, the disease has become widespread in cannabis-growing facilities across North America. Although severe yield loss associated with duds disease has been recorded, little scientific information is available to growers in order to contain HLVd. Consequently, this review aims to summarise all of the scientific information available on HLVd so as to be able to understand the effect of HLVd on yield loss, cannabinoid content, terpene profile, disease management and inform crop protection strategies.

# HpLVd in Hemp

Plant Disease • 2022 • 106:1334-1340 • <https://doi.org/10.1094/PDIS-11-21-2415-SR>

Special Report

*e-Xtra*\*

## An Overview of Pathogens Associated with Biotic Stresses in Hemp Crops in Oregon, 2019 to 2020

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“BCTV, a curtovirus, and hop latent viroid (HLVd) were the predominant pathogens detected from field and indoor grown hemp. Worland-like strains of BCTV represented 93% of all curtovirus detections. Eighty percent of HLVd detections occurred from plants that originated from indoor growing facilities.”

# HpLVd-Caused Symptoms

## In Cannabis

- **Stunting**
- **Leaf malformation and chlorosis**
- **Brittle stems**
- **Outwardly horizontal plant structure**
- **Reduction of flower mass and trichomes**

- Warren et al., 2019 and Bektas et al., 2019

# HpLVd-Caused Symptoms

## In Hemp

**“HpLVd-infected plants may remain asymptomatic or may exhibit stunting and brittle stems. In the field, symptoms in early growth stages may resemble symptoms of nutrient deficiency. Plants infected in early growth stages may be stunted and appear to grow out of the disease as the season progresses. It is unknown whether HpLVd can affect the chemical composition of hemp varieties.”**

<https://pnwhandbooks.org/plantdisease/host-disease/hemp-cannabis-sativa-viroid-diseases>

# HpLVd-Caused Symptoms



Hemp shoot showing early symptoms due to infection by HpLVd. Photo by K. Frost, Oregon State Univ.



Hemp shoot showing later stage symptoms due to infection by HpLVd. Photo by K. Frost, Oregon State Univ.



Detached hemp leaves that are positive for HpLVd. Photo by C.M. Ocamb, Oregon State Univ. 2021.

<https://pnwhandbooks.org/plantdisease/host-disease/hemp-cannabis-sativa-viroid-diseases>

# A Suspected HpLVd Case I

## Grower's observation

1. Leaf tip curling and cupping
2. Nodes growing horizontally from the stem
3. Leaves leathery or crinkled.



Photos by client

# A Suspected HpLVd Case I



Vascular  
discoloration



*Fusarium  
oxysporum*

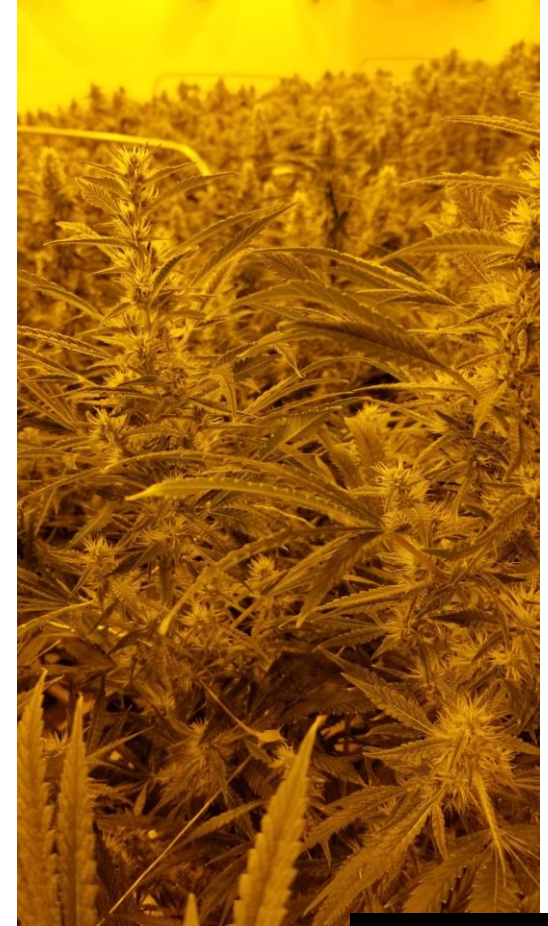
# A Suspected HpLVd Case II

## **Grower's observation**

Only a few of plants exhibiting stunting, odd terpene change in certain cultivars

## **Lab Test**

Negative for HpLVd by sequencing



Photos by client

# The Key Questions

- What are the symptoms of your cannabis crop?
- Have you examined the plants systemically (from flower to root)?
- What evidence points to HpLVd?
- Do I need to get the problem diagnosed before seeking HpLVd testing?
- What if the HpLVd test is negative?
- Have I considered other pathogens or factors?
- Can HpLVd be present in plants exhibiting diseases caused by other pathogens?

# Beyond HpLVd: Phytoplasma

- **Phytoplasmas are a group of nonculturable bacteria that live in the phloem sieve tubes of vascular tissue of live plants**
- **They infect plants causing:**
  - **Excessive shoot proliferation**
  - **Witches broom**
  - **Yellowing and stunting**
  - **Little leaf**
- **Phytoplasma can be transmitted by leafhoppers, psyllids, and planthoppers.**
- **Control of insect vectors to mitigate disease spread**

# Beyond HpLVd: Phytoplasma

**Excessive  
branching,  
shoot  
proliferation,  
and witches'  
broom**



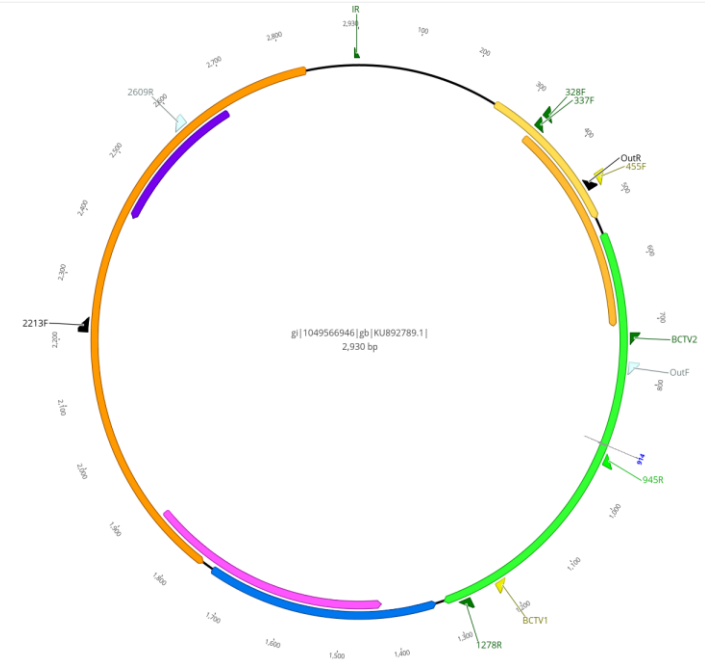
# Beyond HpLVd: Phytoplasma

**Leaf yellowing,  
stunting, and  
little leaf.**



# Beyond HpLVd: BCTV

- 1. Beet curly top virus (BCTV) is a member of the genus *Curtovirus***
- 2. BCTV has a circular single-stranded DNA (ssDNA) genome**
- 3. It is a well-known plant virus that affects many crops, including sugar beet and tomato**
- 4. It is mainly transmitted by the beet leafhopper (*Circulifer tenellus*)**



**NV BCTV whole genome**  
**GenBank OQ628293**

# Beyond HpLVd: BCTV



**Leaf narrowed and rolling upwards**



**Leaf twisting, curly top, and stunting**

# Beyond HpLVd: BCTV



**Leaf rolling, darker in color, and thicker**



**Stunted bush-looking  
with leaf curling and yellowing**

# Beyond HpLVd: Spiroplasma

- ***Spiroplasma citri* is a nonculturable bacterium that lives in the phloem sieve tubes of vascular tissue of live plants**
- **It infects plants causing**
  - **Citrus stubborn disease**
    - **Stunting of growth**
    - **Mottling and chlorosis**
    - **Small leaves**
  - **Carrot purple leaf, stunting, and fibrous secondary root**
- ***S. citri* is primarily transmitted by beet leafhopper (*Circulifer tenellus*)**
- **Control of insect vectors to mitigate disease spread**

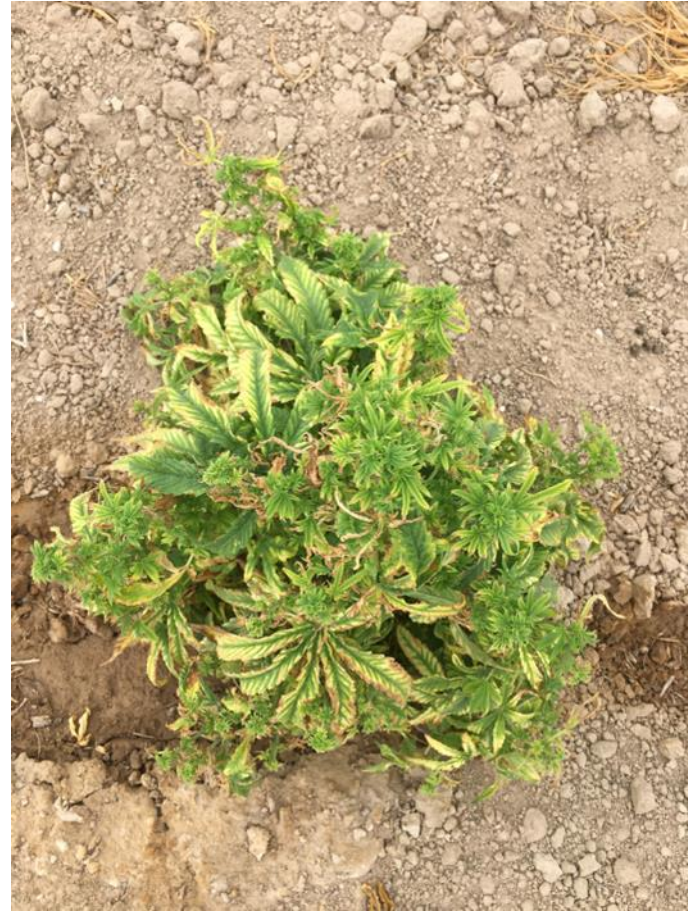
# Chlorosis and Mosaic



# Chlorosis and Mottling



# Yellowing and Stunting



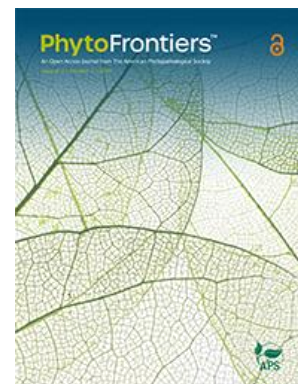
# Abnormal Growth Syndrome



# Hemp abnormal growth is attributed to mono-, di-, or tri-infections of *Spiroplasma citri*, *Candidatus Phytoplasma trifolii*, and Beet curly top virus

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**Published Online:** 28 Jul 2023 | <https://doi.org/10.1094/PHYTOFR-05-23-0064-SC>



# Other Pathogens

- Beet curly top virus
- Hop latent viroid
- *Candidatus Phytoplasma trifolii*
- *Spiroplasma citri*
- Lettuce chlorosis virus
- Citrus yellow vein-associated virus\*
- Cannabis cryptic virus\*
- Cannabis sativa mitovirus\*
- Citrus yellow vein associated virus\*
- Opuntia-like virus\*

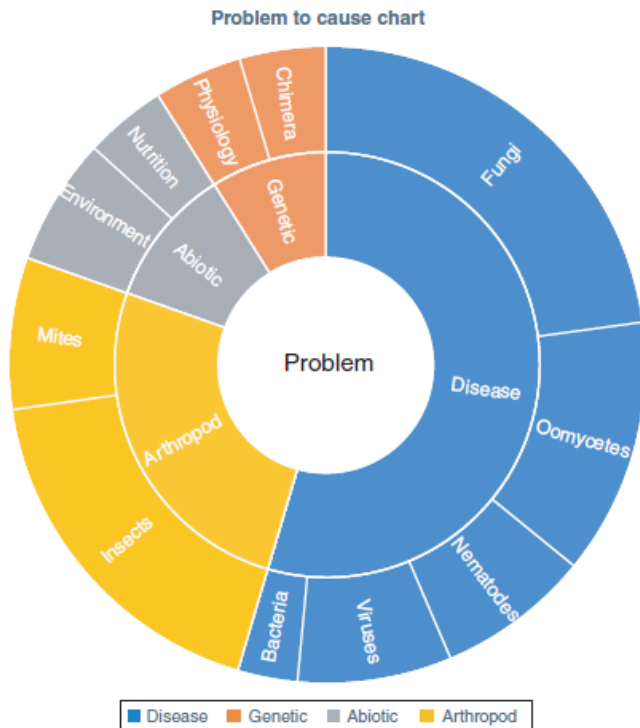
\* Detected by NGS method (Chiginsky et al 2021, Front. Agron. 778433)

|                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
|  |  |  |  |  |  |
| <b>Healthy</b>                                                                    | <b>Witches' Broom</b>                                                             | <b>Leaf Curl</b>                                                                  | <b>Mosaic</b>                                                                      | <b>Chlorosis</b>                                                                    | <b>Yellow &amp; Twisting</b>                                                        |
| <b>Plant 1</b>                                                                    | <b>×</b>                                                                          | <b>×</b>                                                                          |                                                                                    | <b>×</b>                                                                            | <b>×</b>                                                                            |

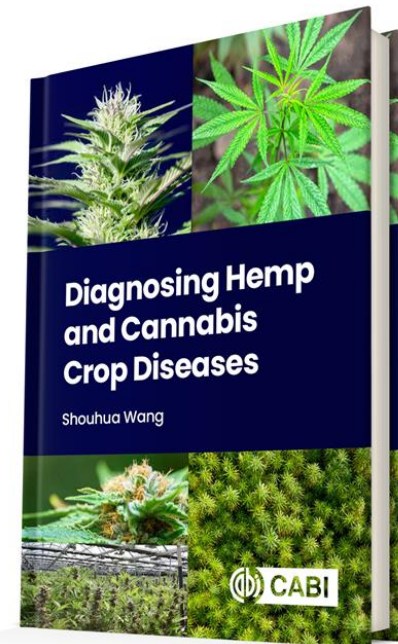
An example of symptom polling to determine the prevalence of each symptom type and then to determine what potential pathogen to be tested

**Wang, S. 2021. “*Diagnosing Hemp and Cannabis Crop Diseases*” CABI Publishing. DOI: 10.1079/9781789246070.0000.**

# The Art of Diagnostics



**Fig. 3.10.** Problem-cause chart of plant diagnostics. Note that diseases and arthropods are major causes of plant problems.



## Additional Resources

Wang, S. 2021. “Diagnosing Hemp and Cannabis Crop Diseases”  
CABI Publishing. DOI: 10.1079/9781789246070.0000.