TUMIGlow™ Diagnostic Platform

A bench top diagnostic device for on-site testing that accurately detects hop latent viroid.

The TUMIGlow platform provides immediate results that are as reliable and accurate as complex PCR tests - but in your facility.

TUMI GENOMICS

referential image

Introduction

Hop Latent Viroid in the Cannabis Industry

Hop latent viroid (HLVd, HLV or HpLVd) is a tiny, molecular parasite that is infectious in plants. This pathogen has been identified as a serious threat to cannabis plants, causing significant yield loss and reducing the quality of the harvested product - otherwise known as 'dudding.'

It is a small, single-stranded RNA molecule that can infect the plant without causing obvious symptoms, making it difficult to detect and control.

Major economic losses are attributed to hop latent viroid due to this pathogen's negative impact on flower quality.

Estimates indicate a +20% total accumulated production loss and some of our customers have sustained infections in 50%-100% of their grow rooms. Management of HLVd is a critical consideration for all cannabis cultivators.

"Estimates indicate a +20% total accumulated production loss..."

Third-party testing can involve long wait times, high costs, and logistical challenges.

Complimenting in-lab with on-site testing can help maintain the efficiency of your operation.

Formula for Success

TUMIGlow™, Onsite Testing Platform

Most on-site technologies on the market suffer from complex procedures, poor accuracy, and low throughput, making their usefulness questionable.

TUMIGlow patented chemistry and technology is the only on-site diagnostic assay on the market that allows simultaneous visual detection of multiple sequences in a single, closed tube.

TUMIGlow tests are stable at room temperature, contain an internal control, and resist false positive/negative results that can be common with other onsite tests.

This technology produces simple, fast results that are as reliable and accurate as complex PCR tests.

High Sensitivity

Detects down to 4 viral copies of viroid (vs. 375 and 7,289 for other on-site tests)

Validated Accuracy

Minimizes false positives and false negatives to limit non-specific results

High Throughput

Processes up to 48 plants in approximately one hour after proper sample preparation

Efficient and Cost-Effective

Reduces dependency on out-of-house testing by pairing in-lab and on-site testing services

Method

Fluorescent Technique

Glow technology is a molecular tool that identifies pathogens or genetic characteristics by detecting specific sequences of DNA/RNA.

Glow reactions are designed with cannabis facility operations in mind. The specialized chemistry in Glow products allows accurate, sensitive results outside of a complex laboratory setting.

High-Throughput Detection On-Site

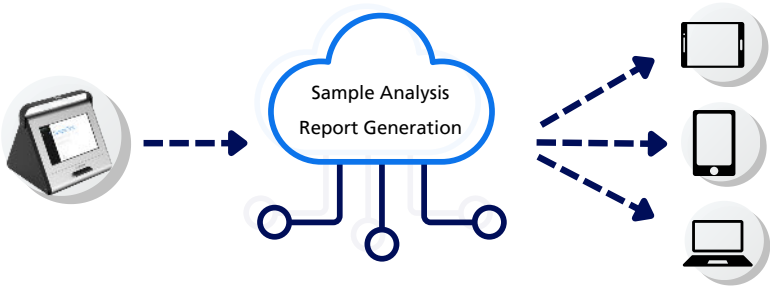
Using our affordable visualization hardware and state-of-the-art software, TUMIGlow can perform 48 assays/hour making rapid, large-scale plant screening possible.

The TUMIGlow platform is the next generation of on-site, do-it-yourself pathogen testing that will revolutionize disease detection in the cannabis industry.

Intelligent Data

Along with the power of accurate, on-site pathogen detection, the TUMIGlow platform also provides intelligent data and insights. The visualization equipment is coupled with software that is accessible using a computer or cell phone.

Cultivators can track diagnostic results throughout their facility and receive actionable insights on pathogen mitigation based on real data from each facility. The suggestions and information are continuously updated giving growers access to TUMI Genomics' scientific team at their fingertips.



TUMIGlow Device

Connect the device to wi-fi and configure the settings

Storage and Configuration

Sample results and device settings are recorded for future testing

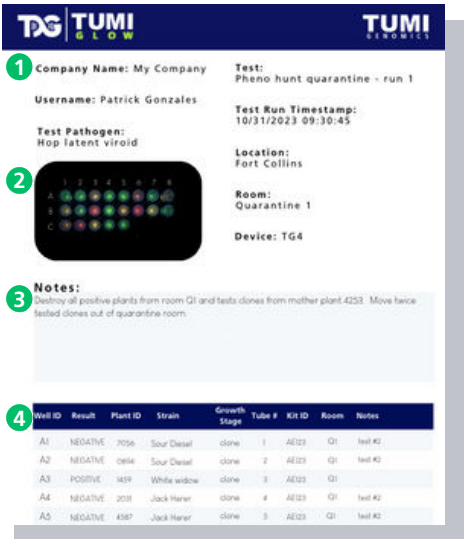
Unlimited Access

Access to reports and validation documents from any device or location

Results

Intuitive and Shareable Report Analysis

TUMIGlow - HLVd Test Report



The TUMIGlow generates digital reports that can be downloaded or shared with other parties.

1. The top portion of the report indexes all the information about the test run.

2. The device's internal mechanics record a photo of the sample results after each run.

3. A section to record notes and share results and cultivation decisions.

4. The results are recorded in a table that allows for manual input regarding the sample name, strain, and any notes.

TUMIGlow software records results and generates a comprehensive testing history.

This feature enhances decision-making by allowing users to quickly analyze trends and patterns.

Logistics

Sensitive and Accurate Results

To be effective at limiting the spread of pathogens, diagnostic assays need to be able to identify low-level infections early, before they spread to other plants. TUMIGlow™ has been optimized to deliver unparalleled performance.

While other available on-site detection technologies detect between 25.3% - 71.2% of the hop latent viroid infections**, TUMIGlow detects >96% of positive samples identified by TUMI Genomics PCR test, making this on-site technology more sensitive than many in-lab qPCRs tests. Growers can achieve lab-level detection sensitivity and accuracy without the need for complex equipment, expertise, or long wait times.

When high sensitivity is required for pathogen detection, in-lab testing is essential; yet, the wait time, expense, and logistical constraints associated with third-party testing can hinder the creation of successful pathogen screening programs.

Until TUMIGlow, hop latent viroid on-site testing technologies had low sensitivity, a high rate of false positives, and low throughput.

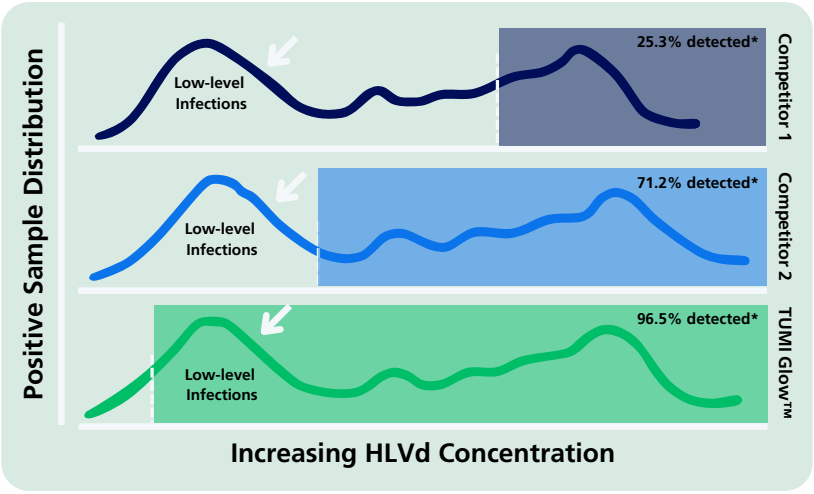
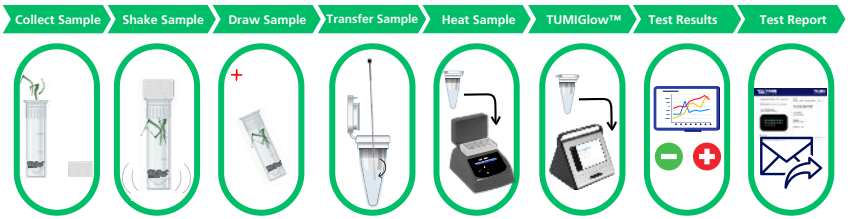


Fig.1 ** Based on published validations from competitors compared to TUMI Genomics qRT-PCR assay.

Procedure

Intuitive Sample Preparation with Simple, Fast Diagnostics

The TUMIGlow™ platform was designed to be used by anyone, without the need of scientific training. The test is completed in five simple steps without the need for complex equipment or lab supplies. The Glow platform has gone through extensive customer use studies and is already being used to screen for human pathogens. With the adaptation of this platform to the cannabis industry, growers will have access to accurate on-site diagnostics that can be performed by anyone.



Facility Hygiene Suggestions

The S.T.O.P. Pathogen Program

For best testing results, maintain a sterile environment and ensure cannabis genetic material remains pure. As no single solution or activity can eliminate the threat of pathogens in a cultivation facility, consider a pathogen mitigation program.

Effective pathogen prevention stems from understanding pathogen biology and transmission. This information can be used to create a comprehensive package of activities that work together to minimize disease.

Creating these programs can be difficult given the varied pathogen pathogen types and their complex interaction with the environment.

To help cannabis cultivators face this challenge, TUMI Genomics has created a pathogen mitigation program called **STOP**, that outlines critical steps in limiting crop loss due to disease.

- **S** Sterile Environment
- **T** Test Regularly
- **O** Organize & Observe
- **P** Protect Your Borders

Performance Specifications

Technical Validation

A limit of detection study determines the sensitivity of a test. The limit of detection is defined as the lowest concentration of pathogen where the test can still detect 95% of the true positive samples. A limit of detection can help you understand how well a test can find low-level/early infections.

To determine the limit of detection (LoD) of the TUMI Genomics TUMIGlow™ we spiked negative plant extract with decreasing amount of HLVd sequence for ten replicates of each tested concentration as shown in the table below. **These studies indicated that the assay can reliably detect down to 4 viroid copies per microliter.**

HLVd Concentration in Sample	Fraction Positive TUMIGlow	Percent Detection Success	Average Cycle Threshold HLVd Target (PCR)	Average Cycle Threshold Plant Target
11 copies/µL	20/20	100%	31.6	27.29
6 copies/µL	20/20	100%	32.4	29.30
4 copies/µL	20/20	100%	33.2	27.98
2 copies/µL	16/20	80%	NaN	26.78
1 copies/µL	10/20	50%	NaN	28.76
0 copies/µL	0/24	0%	NaN	29.35

Fig. 2 Table shows the results from studies performed to determine the LoD of TUMI Genomics HLVd qRT-PCR assay. The identified LoD, or Level of Detection, is indicated in blue.

Inclusivity: The primers used in the TUMIGlow-HLVd tests were carefully designed to allow detection of known HLVd sequence variants. Based on in silico analysis, TUMIGlow-HLVd assay can detect >95% of HLVd sub-species. Analysis of 135 positive samples from customers indicates 99.3% detection of samples from diverse geographical locations including: Canada, United Kingdom, Switzerland, Netherland, Italy, Austria, Portugal, Greece and Thailand.

Accuracy: The TUMIGlow-HLVd test performs with 99.1% accuracy compared to PCR. The TUMIGlow test detects 100% of HLVd(+) samples down to ~20 viroid copies/µL. In-field accuracy studies mirror these finding showing a 98.6% accuracy rate to in-lab qPCR when preformed by real cultivators in their facility.

Specificity: Comparison of TUMIGlow-HLVd primers to the genome sequences of 48 known cannabis pathogens and the cannabis DNA sequence showed no cross-reactivity. Wet lab testing of common cannabis root pathogens such as Fusarium and Pythium showed no interference or cross-reactivity with the TUMIGlow-HLVd test, indicating the test is very specific for hop latent viroid and contaminating pathogens do not affect the results.

TUMIGlow™ Diagnostic Platform

With a background in human diagnostics, the scientists at TUMI Genomics are validating TUMIGlow with the same stringent standards required by the FDA and USDA. After conducting extensive customer testing, we have incorporated grower's feedback into our sampling and testing process.

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