

# Building and Evolving Plant Diagnostics to Serve Nevada's Agriculture and Urban Plant Health

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## SUMMARY

Agriculture has been an essential part of the rural economy in Nevada, producing hay, vegetables, potatoes, wheat, corn, barley, and other commodities. The value of crop production exceeded \$280 million in 2014. Nevada has diverse ornamental plants and landscape trees, which are valuable assets to 2.7 million urban residents. Pests, diseases, and environmental stressors have all been major issues on both field crops and urban plant communities. A plant diagnostic lab is essential to protect Nevada's agriculture and urban ornamental plants by providing accurate diagnosis that leads to effective management of plant diseases and disorders. The Nevada Department of Agriculture Plant Pathology Laboratory (NDA-PPL) was built to provide plant diagnostic services to state-wide clientele and regulatory programs. Available diagnostic approaches include microscopic examination, culturing, nematode extraction, bioassay, serology, conventional and real-time PCR, and DNA barcode analysis. As a regulatory diagnostic lab, NDA-PPL introduced USDA-CPHST diagnostic protocols and became accredited by the National Plant Protection Laboratory Accreditation Program, with two diagnosticians certified to perform molecular testing for *Phytophthora ramorum* and citrus greening disease. NDA-PPL also adopted the National Plant Diagnostic Network (NPDN) quality management system to ensure a timely, accurate, and reliable diagnosis, and have earned an accreditation from the NPDN STAR-D program. With good lab practices and a broad range of diagnostic protocols, NDA-PPL is providing high-quality services to commercial farmers, organic and small producers, nurseries, landscape professionals, pesticide applicators, master gardeners, extension agents, arborists, governmental programs, and homeowners. NDA-PPL is the only plant pathology diagnostic facility in the state, therefore it embraces regulatory, extension, and applied research components to meet the needs of diverse clientele and stakeholders. Regulatory plant samples from state inspection and certification programs are diagnosed in timely manner to support disease regulation, commodity promotion, and export. Samples from general public, extension agents, and horticultural professionals are processed to identify the cause of common or new problems. Diagnostic results and recommended management practices help clients to correct problems and keep plants healthy. In addition to sample diagnosis from a state-wide perspective, NDA-PPL conducts USDA-PPQ CAPS and Farm Bill survey projects and analyzes approximately 1,200 plant and soil samples annually. Survey data document the absence/presence of exotic pathogens and help promote export of Nevada commodities to international markets. To respond to disease outbreaks, the lab also functions as a scientific resource to research the cause and nature of an outbreak. A rapid response is provided to growers so that the damage to crops can be mitigated effectively. NPDN plays an essential role in helping the lab evolve to a new level by networking and providing funding for lab personnel and trainings. Supporting the NPDN will benefit agriculture and citizens of Nevada as well as the entire nation.

## Exotic Disease Diagnostics and Survey

The Plant Pathology Program conducts statewide surveys for exotic plant diseases and nematodes. Major targeted pathogens include *Phytophthora ramorum*, cyst nematodes, phytoplasma, *Liberibacter*, *Xylella fastidiosa*, *Ralstonia solanacearum*, and others. Survey data supports early eradication and promotes export of Nevada grown commodities to international markets. Annual survey of cyst nematodes on potato crops helped facilitate the opening of Japanese market for Nevada grown potatoes in 2012.

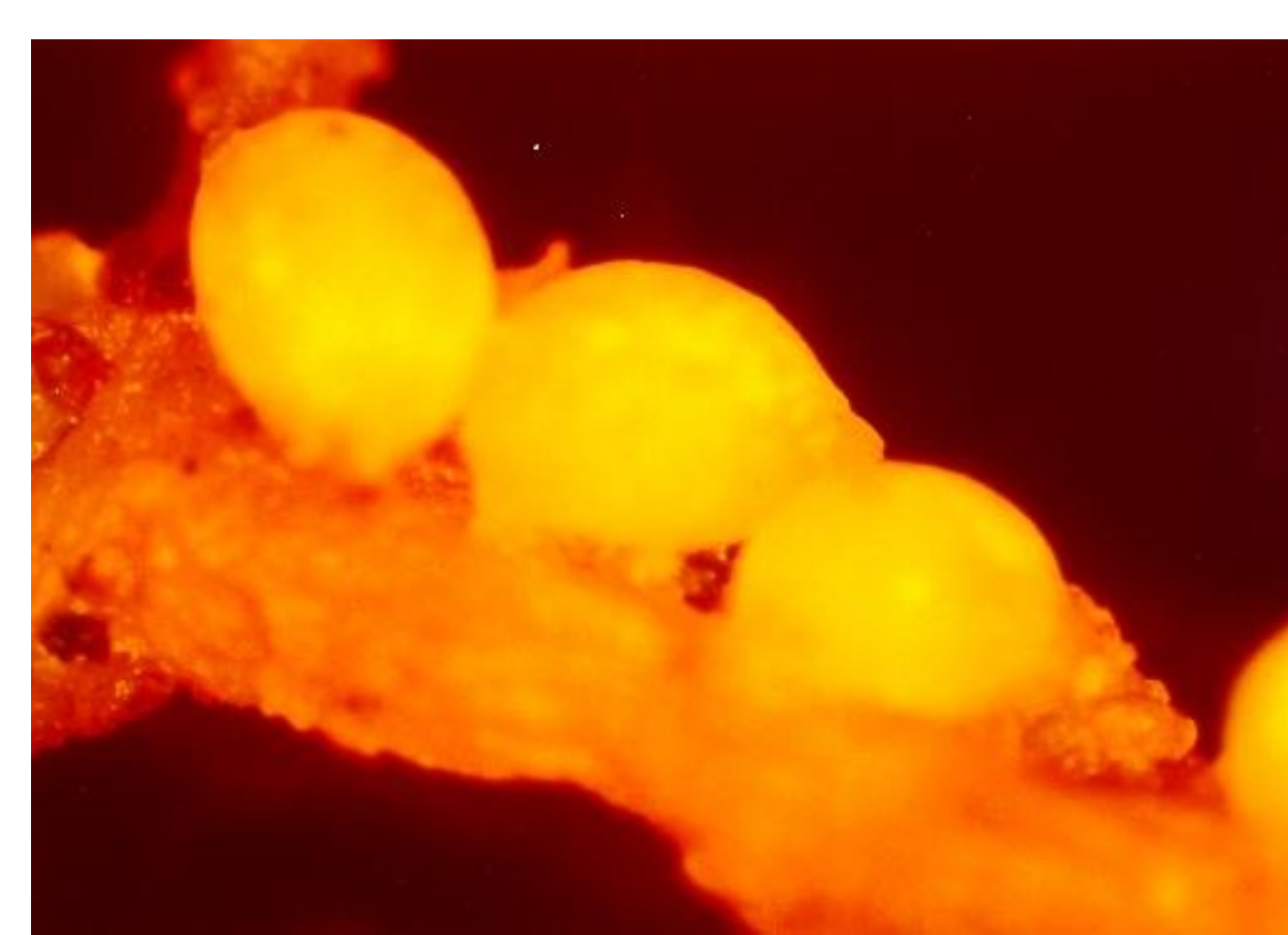


Figure 1. Cyst nematode females feeding on the root of a clover plant.

## Quarantine Disease Diagnostics and Monitoring

The Plant Pathology Diagnostic Lab supports annual monitoring and detection of state quarantined plant pathogens such as Allium white rot fungus (*Sclerotium cepivorum*), and stem and bulb nematode (*Ditylenchus dipsaci*), mint wilt (*Verticillium albo-atrum*), late blight (*Phytophthora infestans*), and lethal yellowing (*Candidatus Phytoplasma palmae*). Early detection of these pathogens helps prevent their spread in agricultural fields or urban environment. The white rot disease monitoring helps ensure healthy production of allium crops in Nevada.



Figure 2. White rot is a major limiting factor for sustainable production of onion and garlic crops.

## Nursery Disease Diagnostics and Inspection

Nursery stock movement is one of most effective pathways for spreading regulated and non-regulated plant pathogens into the state. The Plant Pathology Diagnostic Lab supports state nursery inspection and enforcement program by providing timely lab testing and recommendations for disease eradication. Lab members also inspect nursery plants for *P. ramorum* and other *Phytophthora* diseases when nurseries receive *P. ramorum* host plants from quarantine zones or under a trace forward order. Lab-backed inspection program has ensured clean nursery stocks for consumers.



Figure 3. Basal petiole rot and leaf blight caused by *Phytophthora nicotianae* on Mediterranean fan palm, first detected in North America by NDA-PPL.

## Seed Crop Disease Diagnostics and Certification

The Plant Pathology Diagnostic Lab supports annual seed crop inspection and certification by providing diagnostic testing services. Major seed crops include alfalfa, triticale, wheat, and potatoes. Testing data are used to determine the eligibility of crops for seed production based on allowable disease tolerance and the eligibility of commodities for export to foreign countries according to the phytosanitary requirements of importing countries. GMO tests are also provided upon request of seed producers.



Figure 4. Spring black stem and leaf spot caused by *Phoma medicaginis*.

## Urban Forestry and Ornamental Plant Diagnostics

Nevada has diverse ornamental plants and landscape trees. The Plant Pathology Diagnostic Lab accepts plant samples from urban residents and tests samples for diseases and disorders. Management recommendations are provided to clients based on the problem diagnosed. Timely and correct diagnosis of problems associated with Nevada urban plants leads to effective remedies and reduction of unnecessary pesticide use.



Figure 5. Canary Island date palm wilt caused by *Fusarium oxysporum* f. sp. *Canariensis*.

## Regulatory Diagnostics and NPPLAP Certification

The laboratory introduced USDA-CPHST diagnostic protocols and participated in the National Plant Protection Laboratory Accreditation Program (NPPLAP). Lab members are trained to be competent in performing molecular diagnostic testing and then certified to perform molecular tests for *Phytophthora ramorum*, the pathogen of sudden oak death, and *Candidatus Liberibacter* spp., the pathogen of Citrus Greening, also known as Huanglongbing (HLB).

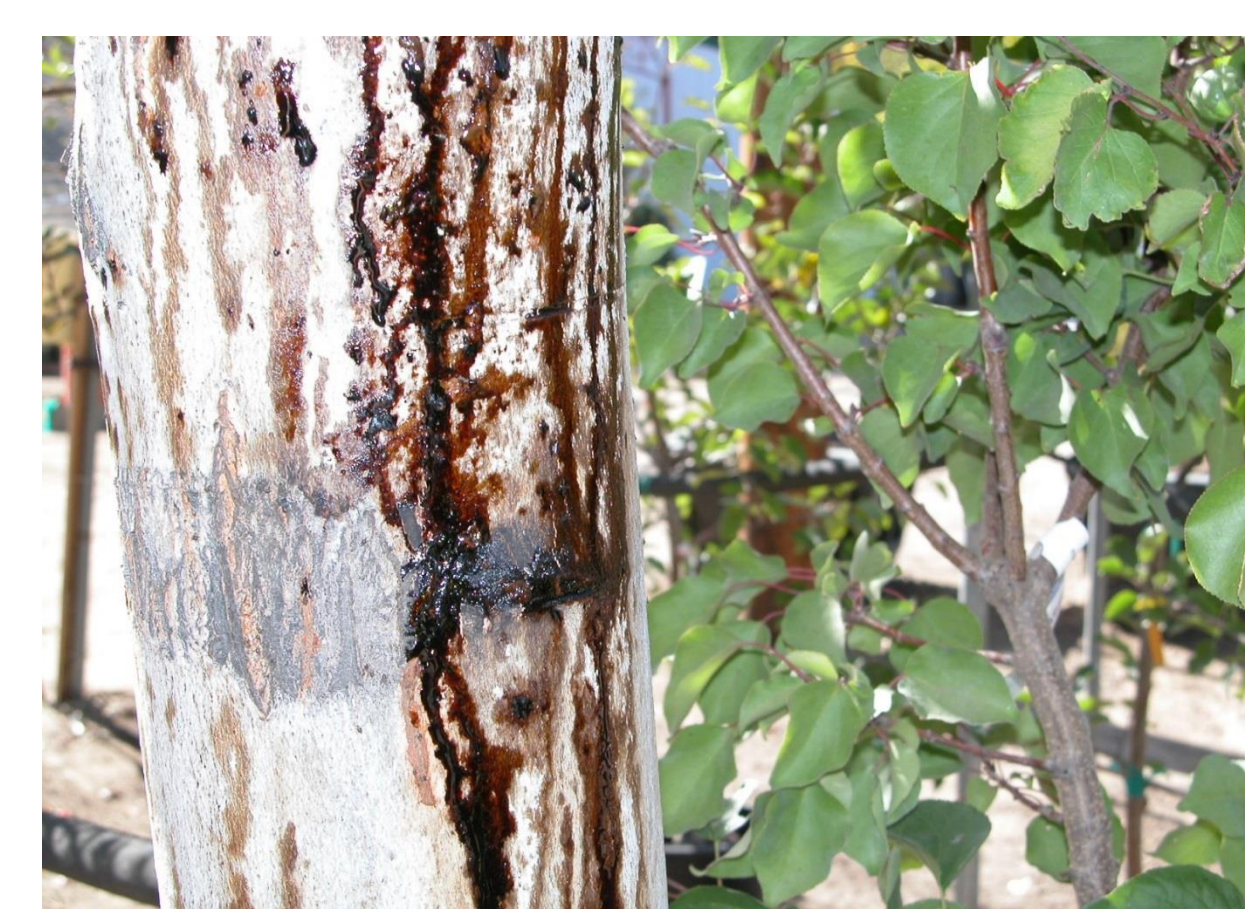


Figure 6. Maple bleeding canker disease, resembling Sudden Oak Death, was found to be caused by *Phytophthora cactorum* and other species.

## Clinical Services and NPDN STAR-D Accreditation

The laboratory functions as a state-wide plant diagnostic center to meet Nevada's plant health needs. The lab implemented the NPDN quality management system to ensure a timely, accurate, and reliable diagnosis. Its clientele include commercial farmers, organic and small producers, nurseries, landscape professionals, pesticide applicators, extension agents, master gardeners, arborists, and homeowners. Annual online survey from clients is conducted to ensure the lab is providing satisfactory services they expect.



Figure 7. The NPDN STAR-D Board granted the lab as a STAR-D accredited plant diagnostic lab in 2015. The lab is therefore bound to the STAR-D requirements and standards (NPDN-SYS-900) governing all lab practices.

## Research on New Disease Outbreaks

Disease outbreaks often occur when a pathogen is first introduced and/or environmental conditions favor the disease development. The lab is usually called by farmers who request assistance to investigate the cause and nature of an outbreak. Lab members work effectively to test and confirm the causal agent using microscopic, serological, and molecular approaches. Management is therefore prescribed to mitigate the damage.



Figure 8. First detection of cucumber leaf spot caused by *Alternaria alternata* in Nevada.