



Behind the Scenes: Diagnosing Tree Disorders in the Lab

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If only trees could talk, especially when they're not well. They could tell us where it hurts. Or maybe why they're looking a little peaked.

Often when a tree or shrub is ailing, the cause isn't obvious. There's a fair amount of investigative work an arborist or plant health care technician needs to do to find the problem. Sometimes that means taking a particularly up-close look by way of a tissue sample. A laboratory analysis can make the difference by figuring out what's wrong and in developing an effective treatment plan.

But how does a lab come up with a diagnosis? The Bartlett Plant Diagnostic Lab, a facility of Bartlett Tree Experts located in Charlotte, NC, examines an average of 7,000 plant samples for clients annually. It routinely identifies a variety of fungal and bacterial diseases, arthropod pests, chemical and physical factors that cause plant disorders, as well as impacts caused by rodents, birds and nematodes. Let's take a look at how the investigative work of a Bartlett diagnosis unfolds.

Assessing the conditions

Before a single sample is taken, the arborist must identify the plant species, and consider its cultural needs and susceptibility to pests and disease. This sets the stage for assessing the condition of the tree and its surroundings, in a quest for answers to a host of questions. What are the symptoms? Is the canopy a uniform color? Are the leaves/needles normal size and color? Is there branch dieback, and if so, are multiple



The location on the plant where an arborist takes a sample to submit for lab diagnosis is key.

Photo courtesy of: Bartlett Tree Research Laboratories

limbs affected? Are there cankers or signs of physical injury on affected branches? Is it a newly planted tree? Is there an adequate mulch ring? Is the root collar buried? What's the site situation with regard to drainage, terrain, sun exposure? Where is the tree in the landscape? Is it dwarfed by another tree? What kind of soil is it growing in? Is the soil compacted?

Answers to these types of questions are important for two reasons. They help the lab diagnostician, who won't have the benefit of actually seeing the tree in the field. And they help the arborist determine the best place for taking a sample that can offer the most clues.

Generally, the rule of thumb is for the arborists to submit samples that fit into a one-gallon zip-lock bag. They're shipped in a tightly sealed container to prevent any insects or other harmful disease-causing agents from escaping en route to the lab.

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Before the arborist sends the physical samples to the lab, a plant-submission form is prepared using an electronic web-based system and attaches a printout of it is attached to the sample bag. The printout provides important diagnostic information as well as a unique sample number, which aids in tracking the status of the sample throughout the diagnostic process. So whether the arborist is out in the field or in the office, he can use the online submission system to instantaneously submit key observations and digital photos – which greatly help the clinicians – to the lab.

Once the sample arrives at the lab, a technician checks in the sample number electronically, which also registers an arrival date.

The detective work begins

Now the serious detective work begins. Like a made-for-TV detective story, the investigation is methodical and meticulous. The diagnostician takes the sample out of the bag and does an initial assessment.

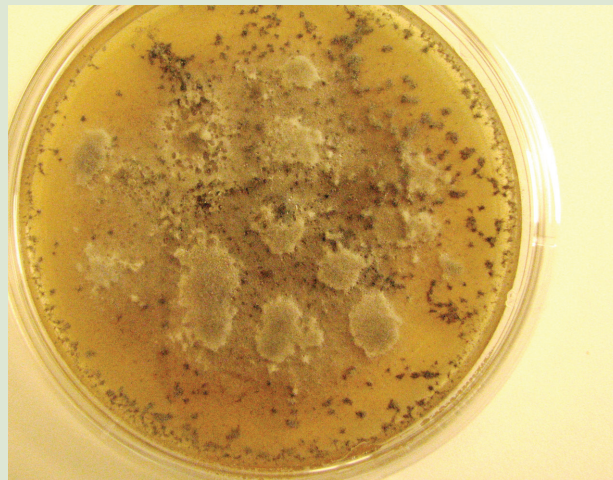
She reads the attached printout and sees that the arborist has submitted digital photos. She types the sample number into the system, which pulls up the images for her to view.

She's ready to take a look with the microscope, searching for any clues, signs, symptoms that can lead to a diagnosis. She'll hunt for them on the top-side and underside of the sample, look all around the stem, cut into the woody tissue to see if it's alive or if there's any discoloration below the bark.

Sometimes the diagnosis is more of a confirmation. She already has a fairly good idea before even taking the sample out of the bag that the problem is spider

mites, for instance. And sure enough, the view through the microscope confirms it. While she's looking, she also inspects carefully for naturally-occurring, beneficial organisms that control the pest, which could influence treatment recommendations.

But seeing spider mites, in this instance, doesn't necessarily close the case. Just because she sees spider mites, doesn't mean they caused the tree's problem. She consults other clues that the arborist has included on the printout. If he has reported localized



The fungal culture isolated from the stem tissue of a boxwood plant. The fungus is growing on a specialized nutrient agar in a Petri dish designed to maximize bacterial growth.

Photo courtesy of: Bartlett Tree Research Laboratories

see something like a bump on the stem that has erupted through the bark. Closer examination of the tissue through a microscope reveals a fungal fruiting structure. To identify the fungus, she looks at the spores under higher magnification.

If the stem tissue has no outward sign of a fungal infection, she cuts away the bark in search of dead/dying or discolored tissue. For example, the systemic fungal disease *Verticillium*, when present on certain host plants, discolors the tissue beneath the bark. To confirm *Verticillium*, she cultures the tissue using an agar medium or moist chamber to encourage the fungus to grow, making identification possible. Because this process adds time to the diagnosis – anywhere from a few days to a week or more – she can notify the arborist with preliminary results and make suggestions for management strategies.

There are no guarantees that a culture will be successful, since the fungus may have already died. In this case, she will provide suggestions on how to resample for the particular disease to ensure the best chances for successful culturing.

chlorotic stippling – or tiny yellow spots – on the leaves, and microscopic examination reveals a heavy infestation of spider mites on the sample, they likely are the culprit.

But if the arborist's notes indicate that the tree is a large oak with extensive dieback across the entire canopy, she has reason to believe the cause of the dieback is not the mites. Further investigation will be necessary. (While not the cause of the problem, the mites might still need to be treated, too.)

Growing a culture

Sometimes the diagnostician will

When no pest is found

Sometimes, even after the diagnostician has looked high and low, over and under, the diagnosis is "no pest found." That suggests that it is probably not a disease or insect that's causing the tree's problems but something environmental. This could involve how the tree was planted, how much moisture it receives, soil conditions, nutrients and so on.

Often the next step in that situation is to do a soil nutrient analysis. If there are nutrient deficiencies or imbalances, the soil analysis results will provide the arborist with specific recommendations of nutrients and amounts needed to



A close-up tissue sample as viewed under a microscope, showing the tell-tale streaking caused by infection with verticillium.

accomplish the fertilization needs.

If the soil analysis indicates that the nutrient levels are right for the tree, but the tree is chlorotic, it might have root disease.

Sampling roots

An arborist might see hints that a tree is suffering from root rot disease out in the field. If so, he can perform an on-the-spot test for the fungus-like organism, *Phytophthora*. The test is similar in manner to a home pregnancy test.

If the root rot test is negative and the arborist feels the conditions are optimal for the disease, he can submit a root sample to the lab for more sensitive testing. The field test provides fast results and can help the arborist and property owner decide what action they might like to take right away, if any. Findings from the lab take about a week, which is still a relatively fast turnaround for a diagnostic test of this kind.

When the lab makes a diagnosis, the diagnostician enters the results into the company's online system, which generates a detailed report. This speeds information transfer to the arborist, enabling him to rapidly make the correct treatment decisions. He can also provide the report and supporting documentation, including the digital photographs that accompanied the sample, via email to his client. The paperless system is not only efficient, but it also helps conserve resources and "green" operations.

The diagnosis may also be submitted to the National Plant Diagnostic Network system, serves a consortium of government agencies and universities providing rapid diagnosis of plant pests and diseases. Bartlett is the only private company that is part of the network. While cooperation with NPPDN allows sharing of pest information among other professionals, to protect client confidentiality, no personal information regarding the client or address is shared.

Trees may not be able to talk about

what ails them. But through careful observation on site, conscientious tissue sampling, dogged clinical detective work and informed treatment options, they can benefit from the best resources for getting back onto the road to recovery. 🌿

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