

# The 20 Questions of Plant Problem Diagnostics

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Proper diagnosis of plant problems is a key factor in plant health management. As urban forester Alan Siewert quips: “Treatment without diagnosis, as in medicine, is malpractice.” Despite this, diagnostics is often not given adequate attention.

Typically, diagnostics is a process to come up with the best possible explanation of why a good plant has gone wrong. Unfortunately, diagnostics almost always involves unknown variables and uncertainties that make an absolute slam-dunk diagnosis the exception, rather than the rule.

Nevertheless, if diagnostics is the start for finding proper treatment, the place to begin is to consider the questions that must be answered. You do not necessarily need to know the answers to all of the questions, nor do you have to ask them in order. Often, however, failure to accurately answer some of the early basic inquiries at the start is the reason for the faulty diagnosis.

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## **Question 1: What Is the Plant?**

This is the first of three key questions concerning the plant itself. It is one of the reasons why truly useful, comprehensive diagnostic keys are so difficult to create — the plant ID key alone would be huge. In diagnosis and treatment, determining whether a plant is a pine or a spruce, determining if it is naturally variegated or deciding if it is supposed to be a dwarf are all crucial.

Spend time focusing on what plant you are looking at or having described to you. Many diagnoses flounder by initial misidentification. Identifying a plant properly leads to a focused consideration of questions such as the ones that follow.

## **Question 2: What Is Normal for the Plant?**

Plant characteristics are variable enough that what is perfectly healthy for one plant may be a sign of a serious problem for another. A good example can be found in deciduous conifers such as bald cypress, dawn redwood, and larch. These three trees bear cones and needles, and neophyte plant lovers may think they are evergreens.

However, they are indeed deciduous, with fall colors ranging from spun gold to reddish brown, followed by leaf drop. Many a bald cypress has felt the bite of the

saw from new homeowners who notice a completely brown-leaved tree in their new landscape in late fall. Indeed this total browning of foliage would be a sign of almost certain death on a true evergreen conifer, such as pine. Knowing how to identify these deciduous conifers and understanding that their fall color and leaf drop are normal can be all you need for proper diagnosis.

Similarly, knowing that some yews, such as *Taxus* 'Helen Corbit,' naturally have needles trimmed in bright yellow should give a horticulturist pause if someone wonders if the yellowing is due to photosynthetic-inhibitor herbicide injury. Knowing that 'Lemon Drop' poinsettias are supposed to have yellow bracts, rather than the more familiar red, white, or pink colors of most poinsettias, is a key answer to concerns that something is wrong with the plant's nutrition.

Knowing that the greenish, straplike bracts on lindens naturally turn brown after flowering is key to responding to a concern that the browning is associated with some type of fungal disease. And if you understand that older sweet gum stems and young hedge maple stems often develop corky wings (almost like winged euonymus), you will realize it is not some strange sort of distorted growth on the plant.

These examples fail to prove that there is nothing wrong with the plant. After all, the *Taxus* may very well also have herbicide injury, the poinsettia may have a nutrient deficiency, there may still be diseases on the linden, and there may be other factors causing growth distortions on the stems of sweet gum and hedge maple. Nevertheless, understanding what is normal for a particular plant is a great early perspective in the diagnostic process.

### Question 3: What Are the Common Problems with the Plant?

Another good diagnostic perspective is to consider a plant's common problems. All plants have their own set of diseases, insect problems, and cultural dilemmas; there are no problem-free plants. Pondering these common quandaries can create somewhat of a bias, especially if you are seeing something new, but it helps rule certain problems out.

For example, fire blight, caused by the bacterium *Erwinia amylovora*, causes a blighting of shoots that result in discolored leaves and a curling of the shoot often characterized as a shepherd's crook. This symptom is helpful in considering fire blight as a possibility. However, such symptoms can also be caused on many plants by far simpler problems, such as moisture stress, resulting in leaf and shoot wilting.

For which plants should fire blight be considered a possibility? As it turns out, fire blight occurs only on plants in the rose family (rosaceae). So, if you see a crabapple, firethorn, or mountain ash with a shepherd's crook symptom, fire blight should be considered and investigated. If the plant is a maple, white ash, or pine — not members of the rose family — fire blight is not a possibility.

Knowing your plants (and even what family they are in) is a great starting point for diagnostics. This, of course, helps not just with identifying infectious diseases like fire blight, but with other problems as well.

Consider a yew or rhododendron growing in poorly drained soil. Knowing these plants are particularly prone to root decline and root rot in poorly drained sites

helps immensely with a proper diagnosis when plant decline is evident. It should not blind you to other possibilities, but it certainly is the type of smoking gun that should be investigated.

#### **Question 4. What Do You See That Looks Abnormal?**

It is important to clearly consider and list what signs and symptoms are present that make you believe there is a problem in the first place. For example, are there signs of insect or mite feeding? If so, is the injury from pests with chewing or sucking mouthparts? Similarly, are there signs of fungal diseases, such as the orange fungal growth of rust disease? Are leaves missing, off-color, abnormally small, or scorched? Is there abnormally peeling bark? Are there girdling roots — or are the roots rotted in the pot or in the soil? Are there abnormal growths such as galls or discolored cankered areas on stems?

Finally, when considering symptoms of plant problems, keep in mind that often there is a series of symptoms, known as the “symptom complex,” which together helps fingerprint a particular problem.

When questioning if lace bugs are a problem, check not only for flecking and yellowing of leaf tissue, but also for tarlike excrement deposits. When checking for *Verticillium* wilt on maple, check not only for leaf scorching and stem dieback but also for discolored streaking of the vascular tissue.

The list can be extended and extended. It is important to walk around the plant — looking at it up close and from far away — and to catalog every noticed item as you work on your diagnosis of what may possibly be multiple problems.

#### **Question 5: What Is the Overall Health of the Plant?**

It is a good reminder to put into perspective overall plant health. Presumably you have found something abnormal or you would not be continuing with the diagnosis, but step back for a moment to consider overall health. This helps later in terms of what you will recommend and how important various problems on the plant might be, but it also helps provide focus relative to how long problems might have been present. Consider, relative to a healthy specimen of the same plant, such questions as whether leaf size and color are normal, if the canopy is full, or if the growth rate is normal.

For example, if you measure the space between the sets of bud scale scars on the twig of a woody plant, you can tell how much it has grown in recent years. It is a little tricky to know what is a normal rate of growth and whether lower than normal rates necessarily mean the plant is unhealthy. However, declining rates of growth over the past several years can be telling, and they can often even be traced to a particular event, such as installation of new sewer lines or a new driveway. Conversely, pointing out normal annual growth can also help allay fears that something major is wrong with the plant — for example, on maple when all that is found is some tarry spots on the leaves.

#### **Question 6: What Exactly Do You See?**

After stepping back to consider the overall health of the plant, force yourself to step back again to consider in more detail Question 4 — What do you see that looks abnormal?

The key to diagnosis is often in such details, sometimes related to others who help with the diagnosis, such as a diagnostic lab technician or coworker in your company. A good example of this is the difference in symptoms between maple anthracnose and physiological leaf scorch of maple.

To the casual observer, both problems involve blotchy, scorchy, brown discoloration of the leaves. However, the details are quite different. With anthracnose, which is caused by a fungus, the blotched areas are more of a reddish brown than a tannish brown, but more importantly, they are concentrated along the leaf veins.

With physiological leaf scorch, caused by excess evaporation of water from leaves due to a variety of factors, the blotches are not concentrated along the leaf veins and are typically more to the outer margins of the foliage. Knowledge of this difference in symptoms is the sort of fine-tuning that diagnosticians develop as they improve their observational and reporting skills.

As can be seen with this maple example, noticing where symptoms are occurring is critical. *Diplodia (Sphaeropsis)* tip blight of pine is characterized by browning and stunting of new growth on young Austrian, red, Scots, and mugo pine shoots, in addition to dieback of this new growth (the growth farthest out on the branch). This disease typically occurs on the bottom branches of the tree first and works its way upward over the years.

Compare this to the normal seasonal loss of inner needles from previous years that occurs on pines. Every fall, many people become worried about the yellowing, browning, and falling needles on pine, even though loss of older needles is normal. Each evergreen species drops needles of different ages, so good plant

identification and knowledge is essential. Careful observation of the details of whether the browning needles are on new or old growth is crucial for good diagnosis.

## Question 7: What Do You See on Other Plants?

Now take note of the condition of surrounding plants. Are other specimens similarly affected? What is their general health? If you are looking at a grouping of a particular species, does symptom severity seem to relate to any kind of gradient of drainage or sun exposure?

Trying to answer such questions often provides key clues about major environmental factors. If, for example, a number of different vegetables in a garden are all dying, it is unlikely they are deteriorating from an infectious disease, since most disease-causing pathogens have limited host ranges. It is more likely that a major environmental factor, such as improper herbicide use or extended flooding, is involved.

Often noticing what is occurring on overhanging plants can prevent embarrassing misdiagnoses. Scale insects, which suck sap from plants, excrete this processed sap out the other end. Often this sugary, clear “honeydew” then becomes covered with a sooty mold fungus that simply grows on the sugary substance, rather than the plant tissue itself.

Consider what happens when a bed of pachysandra is growing under an oak tree infested by scales. The honeydew is excreted, falls from the tree onto the pachysandra, and then the sugary substance is colonized by the sooty mold fungus. If you do not look closely at the pachysandra, you might assume the presence of the sooty mold fungus is

associated with a scale infestation on the pachysandra.

## Question 8: What Are the Plant's Site Conditions?

Question 7 leads directly to a more focused examination of the site in which the plant is growing. A few key site characteristics can include everything from soil characteristics and exposure to sun and rain, to construction history and competition from other plants.

The soil type relative to drainage, extent of compaction, amount of organic matter, and acidity / alkalinity can tell a great deal about the success and failure of various plants. Poorly drained soils with poor internal aeration sooner or later result in death and *Taxus*.

Acid-loving plants often develop yellowing between the veins (or to put it more stuffily — interveinal chlorosis) if growing in alkaline soils (pH above 7) due to iron deficiency. This can be diagnostically investigated by using soil tests and even plant-tissue analysis — or by simply looking at the plants on-site.

If you notice rhododendrons, birches, white pines, and other acid-loving plants thriving in a location, then a diagnostician might suspect the yellowing of leaves on the similarly acid-loving pachysandra is due not to iron deficiency, but rather to other factors such as overexposure to sun.

Sun and shade exposure is also critical to the success of many plants. Japanese maples tend to thrive in protected sites, developing physiological leaf scorch in hot, sunny areas.

Flowering dogwoods generally do poorly in open, hot sites (and often develop borer problems if stressed) and also in densely shaded sites where diseases, such as

dogwood anthracnose, are favored. Partial shade is best for flowering dogwood.

Exposure to wind can result in desiccation of tissue of broad-leaved evergreens, such as rhododendron in winter, and should be considered while diagnosing these plants and the extent of wind exposure. Even exposure to rain can be an important clue. Diagnosticians often miss the implication of overhangs from houses when wondering why herbaceous ornamentals near structures seem to be languishing despite adequate recent rainfall.

The effects of construction are also a factor that should be investigated relative to the site. How much soil grades were raised; the effects of bulldozers on soil compaction and root destruction; installation of sewer lines, driveways, roads, and structures all play a role in plant health, often many years after the fact. Diagnosis would be easy if raising the soil grade six inches during construction activity caused trees to fall over within a week or two.

The truth, however, is that this kind of stress on root systems, due to reduced oxygen concentrations for the now-buried roots, can have effects for years from the contribution to overall plant stress. Nailing down exactly how much damage is due to various factors is difficult — if not impossible — to pinpoint, but it is the job of the diagnostician to put it into as clear a perspective as possible.

## Question 9: Who Knows the Most About the Plant?

One of the limits of diagnosing plant problems, unlike with human medicine, is that the patients cannot talk. However, asking questions of the person who takes care of the plant often yields the most important information of all. People who

work in a diagnostic laboratory will tell you the information on the sample is often more important than the sample itself. Try to find out from them the answers to the next question.

### **Question 10: When Did Symptoms First Appear?**

Although listed as No. 10 here, this is a very important question: When did the symptoms of the problem in question first become evident?

Sometimes the answer is unreliable, and we have all heard the up-and-died-overnight scenario. We can check this out, though, by looking at annual growth and symptoms such as long-term branch decay and peeling bark. Sometimes people do provide crucial information that helps solve the problem, such as noting that foliar collapse occurred soon after a spring frost.

The art and science of professional plant diagnostics are often overlooked by those with instant answers to every problem. Beware of those easy answers, especially if the diagnostician did not even ask the question. Diagnostics requires good detective and communication skills, and plant diagnosticians need a thorough knowledge of horticulture, botany, entomology, and plant pathology. But no matter how talented the professional, this combination of skill and knowledge is impossible to master. No one can ever be the perfect diagnostician, and there is always room to improve and grow, to make and correct mistakes.

### **Question 11: What Is the Horticultural History of the Plant?**

This inquiry involves a whole series of important questions, some of which can be

answered only by others, some of which you can determine from evidence at hand. For example, what is the plant's transplant history? Looking at a declining 40-foot tree can be a puzzle that is pretty easily put together when you discover the tree was transplanted two years previously. On younger plants, transplant history is often quite evident. A declining rhododendron that has branches growing out of the ground and is planted six inches deeper than the root-ball grade tells a great deal about the causes of decline.

The same combination of questions to ask and clues to look for applies to horticultural practices such as fertilization, mulching, pesticide spray programs, plant hardiness, use of girdling wires, and the source of plant material. You can ask about fertilization rates, but you can often find telltale signs that help ask more pointed questions, such as an excessive pile of granular fertilizer on the ground or on mulch.

Check the depth of organic mulches. The recommended amount is 2 inches to 2-1/2 inches, although more commonly six inches to eight inches (or even more) is applied, or mulch piles up over the years with reapplication exceeding breakdown.

Additionally, mulch is often piled up against the trunk of a tree or the base of a plant. The result of this overmulching may be the reduction of oxygen availability to feeder roots, especially on young plants, and excessive moisture retention may potentially lead to crown and root rots. Mulch mounded against the base of the crown can also provide a perfect protected location for rodents in winter, which can severely damage or kill young, thin-barked trees and shrubs.

Again, consider the always-important question of timing. An irrigation system that is present and seemingly functional

may not have been working during the hottest portion of the summer, when observed damage really was caused. Conditions may be cool and non-stressful in September, but what if a large tree was transplanted on a 100° day in July?

### **Question 12: What Is the Environmental History?**

In addition to what we do horticulturally, it is important to consider past environmental events. How harsh have recent winters been, and how does this match up to a particular plant's hardiness range? Also, severe freezes in a given year can result in plant dieback and death well into a growing season.

Often clients think if a plant flowers normally or leafs out normally, then all is well with regard to surviving winter damage. Sometimes, however, bud tissue breaks. And furthermore, early freeze damage to a plant's cambium prevents that plant from growing beyond that initial bud break, and stems — or the entire plant — may die. These symptoms of delayed winter injury are quite common in cherries, as well as other *Prunus* selections.

Plants may also bud out and look fairly normal well into late spring and early summer. Then hot weather occurs, and the underlying damage to the cambium causes dieback to occur. This type of problem again highlights the separation in time of the cause of damage and the obvious symptoms of this injury that make diagnosis such an art.

If a plant is known to have difficulty under droughty conditions, early hot, dry weather in a given season can have major effects on plants, such as turfgrass and tender perennials, including *Ligularia* and *Astilbe*.

Severe drought in past years should be factored into the current condition of certain drought-sensitive trees, such as beech. How a plant responds to particular additional stress depends upon its entire horticultural and environmental history.

### **Question 13: What Does the Client Think the Problem Is?**

If a diagnostician does not talk to the client directly, oftentimes he or she comes up with a perfectly accurate diagnosis of one problem but does not address the issue of the client's concern. You can make a great diagnosis of Cooley spruce gall adelgid on spruce twigs, provide a proper perspective of how significant the problem is, make accurate control recommendations, and walk away with a job-well-done feeling.

Then you later discover the real concern was why the blue spruce was not as blue as it used to be, or why there were some dead branches on the lower portion of the tree, or what the rows of holes in the side of the tree portend. Always ask for and address client concerns and make other observations as needed.

### **Question 14: What Diagnostic Tools Are Available?**

Useful tools for diagnosis can obviously be high-tech, ranging from ever-more-elaborate microscopes and enzyme-linked immunosorbent assay tests for viruses and fungi in diagnostic labs to equipment from the gas company to check for gas leaks on properties where trees and turf grass along a gas line are dying. However, for horticulturists determining field diagnosis, basic equipment can be far more manageable and less expensive. Here are six basic items:

**Soil probe.** This tool is useful diagnostically for soil sampling to check soil pH

and nutrient levels. It can help explain, for example, foliar chlorosis due to iron deficiency on acid-loving plants like pachysandra, white pine, river birch, and rhododendron growing in alkaline soils. Probes can have more immediate diagnostic uses as well, such as checking to see how compacted or dry soils are or the depth of mulches.

**Hand lens.** A good 20X magnification hand lens is useful to check for mites and small insects on plant foliage or to look for fungal fruiting bodies on leaf tissue.

**Cutting tools.** Good, sharp hand pruners are important for cutting small twigs to look more closely at stem and leaf problems. It is also unprofessional, to say the least, to collect a sample by stripping a twig from a plant rather than making a good pruning cut.

For larger stems, a small foldable pruning saw is also easy to carry. A knife is useful for cutting into a stem to check for discoloration of the vascular system (typical of Dutch elm disease or *Verticillium* wilt disease) or to check stems for the presence of insect borers. Although less portable, pruning poles can also be useful tools to get samples from high in a tree.

**Digging tools.** It is often helpful to dig a bit around the base of a plant to check for girdling roots or twine, to check where the pre-transplant root system was located or to collect a root sample. A collapsible spade is quite handy, but sometimes blunt, wedgelike knife blades can do the trick.

**Recording tools.** It is important to take good notes of what you observe to later refresh your own memory and to accurately relay relevant information to others. Have a good field notebook, as well as weatherproof pens and markers. A hand-held recorder can also be helpful

if you do many field diagnoses. Finally, a camera can help convey symptoms and site characteristics for others and can be a valuable validation of plant condition at the time you inspected the plant. This photographic evidence becomes especially useful if post-visit changes are made, such as the cutting down of an affected tree.

**Sampling equipment.** In addition to soil probes and pruners, it is always a good idea to carry along some large-sized plastic bags for collecting samples. Avoid leaving foliage samples exposed to the heat of the sun, and if collecting soil samples for nematodes, a small cooler can be quite helpful.

## Question 15: What Additional Resources Are Available?

Of course, the most important diagnostic resource you have is your experience and the collective experience of your cohorts. Also be aware of the number of reliable resources on plant identification and selection; problem identification; and specific damage by insects, diseases, wildlife, and other pests. These sources range from books to great web sites to a wide range of educational programs provided by green-industry organizations and university Extension services.

Furthermore, recognize that diagnostic observations in the field sometimes need verification at a diagnostic lab. These labs use microscopic examination, fungal culturing, and a wide range of tests to help confirm or deny the presence of certain problems. Take advantage of university, government, or private diagnostic labs in your area.

In addition, other laboratories specialize in different pieces of the puzzle. Examples are soil-test and foliar-analysis laboratories used for information on possible nutrient

deficiencies or excesses, and analytical laboratories that check for chemical residues in plant tissue.

## Question 16: How Do I Take Samples?

Each type of plant problem can require special techniques to get the best sample back to colleagues or to a diagnostic laboratory. Presented here are a few hints adapted from Ohio State University Extension Bulletin 614, *Disease Control in the Landscape*.

Obviously, many times you can only sample a small portion of a plant, but when large numbers of small plants are affected, collect entire plants, including roots. If 500 rhododendrons are going down, do not just send a leaf or two. Dig plants to keep roots intact rather than simply pulling the material out of the ground. Remove excess soil by gently shaking or washing with water. Do not wet leaves or stems. Wrap roots so clinging soil won't be loose in the packaging. Do not ship wet plants; let them air-dry first.

If only a portion of a plant is sampled, include the part showing symptoms. Also, when possible, collect about a pint of roots, soil, and fine rootlets.

When only localized parts of a plant are affected (leaf spots, stem cankers), ship several examples of the affected parts. Stem and branch sections should include a short section of healthy tissue so the transition area between healthy and diseased tissue is included. For example, if collecting a sample to check for *Verticillium* wilt disease, select one-inch-diameter stem sections about six-inches long, ideally from the area where the stem transitions between healthy and diseased tissue, rather than collecting dead stems.

If shipping, press non-woody plants or leaves on small twigs between paper and put them between pieces of stiff cardboard, then place in a padded envelope. For succulent plants, samples packed in airtight plastic often decay before arriving in a lab. Place the leaves of such specimens between paper towels before packing.

Use strong containers, filling spaces with shredded paper or other materials to cushion the sample in transit. Use rapid mail delivery for best results.

## Question 17: What Else Needs to Be Considered?

By now, having asked all kinds of questions and in some cases consulting others or sending in samples for analysis, a good diagnostician asks for the last time: "What else might I be missing?"

A good example from a recent diagnostic workshop is a situation in which a cherry had some leaf discoloration — namely some bleaching of plant tissue on the leaf margins and between the veins. The assembled diagnosticians asked myriad questions regarding the specific identity of the plant, trying to make sure it was not some type of variegated cultivar. They questioned its horticultural history, especially with regard to the use of herbicides for weed control. Various nutrient deficiencies or excesses were pondered. Chlorophyll-damaging viral diseases were discussed, as were the types of damage caused by insects with rasping and sucking mouthparts. All these possibilities were pretty much discarded while listening to the client and looking at the sample.

Finally, one diagnostician asked whether a driveway had been installed or blacktopped recently. As it turned out,

this was the case two years previously. That led to a discussion among several diagnosticians concerning some of the herbicides used in the process of sealing driveways. Several had experiences with cases in which such nonselective herbicides caused precisely the kinds of symptoms observed on the cherry foliage. At last, they had a smoking gun.

“What else?” should always be a nagging question on a diagnostician’s mind.

### **Question 18: What Is the Diagnosis?**

The last example brings us to several cruel realities of diagnosis. First, sometimes you just won’t have the insight to ask the “What else?” question that starts your light bulb blinking. Second, even when you do ask the question, it usually does not result in an open-and-shut case.

In the cherry situation, after all, diagnosticians still only had a better idea about what had happened to the plant. They had not proved it beyond all doubt. By doing expensive residue analysis of the suspect chemicals in the leaf tissue or in the soil, they might be able to get close.

Sometimes additional analysis helps; sometimes it is too late to find significant amounts of each possible chemical in question. Also, as you might expect, there is little definitive research to show how much of any herbicide in the world it would take to cause the observed symptoms on cherries, or for the particular type of cherry in question, or even what ultimate effect various levels would have on plant health.

The reality is that you are almost always somewhat uncertain as to your diagnosis. A more reasonable goal for diagnosis is to strive to come up with the best diagnosis possible while acknowledging

the possibility of other factors. That being said, it is important to be clear about what you did diagnose and also, often just as importantly, about what you did not find. In reporting your diagnosis, remember to do the following:

- A. Describe the symptoms you observed clearly and in detail.
- B. Identify the problem or problems you think these symptoms signify.
- C. Indicate how you made this connection (consulting with colleagues, references, and lab tests).
- D. List what you did not find. As indicated earlier, what you did not find can often be critical. If you do not find Dutch elm disease or other infectious diseases, if there is no evidence of bronze birch borers or Asian long-horned beetles, and if the symptoms and/or residue analysis is not suggestive of growth-regulator herbicide injury, this may go directly to the heart of your client’s greatest concerns.
- E. Put diagnoses into perspective and provide recommendations.

### **Question 19: What Is the Significance of the Problem?**

After making a diagnosis, it is important to put the suggested problem into proper perspective relative to overall plant health. For example, most pest and disease problems are insignificant relative to plant health. Tar spot on maple looks rather nasty with its blackish midsummer wavy blotches, but it is rarely relevant to the plant because it comes on late in the season and involves relatively little leaf tissue. Powdery mildew of lilac occurs every year and seems to cause little effect relative to overall lilac health and survivability. Most of the mite and insect

galls on plant leaves are quite fascinating but cause negligible effects on plant health.

However, here you need to be a good communicator, to understand your clients, and listen to their concerns. Just because a problem will not affect plant health or, in your opinion, affect aesthetics significantly, does not mean your client agrees. In some sense, plant problems are in the eye of the beholder.

While powdery mildew of lilac may be irrelevant to plant health in one landscape, it may matter a great deal to a client who will simply take his or her business elsewhere if you do not do something about the problem. And it certainly matters to a garden center displaying lilacs in its sales area. Tar spot on maple is rarely a major problem relative to plant health.

## Question 20: What Are My Recommendations?

Finally we've reached the all-important decision of what you recommend to fix the problem.

First, remember that sometimes no action is in order. If the problem is trivial and the customer is not concerned about it, then simply letting the client know that the maple bladder gall mites are insignificant and nothing needs to be done is a good recommendation.

Second, sometimes nothing can be done to make the plant recover. In such cases, often the best recommendation relates to considerations for timely removal of the plant.

Third, when action recommendations are given, always remember the crucial element of proper timing. If you diagnose

pine tip blight (*Sphaeropsis sapinea*) on pine in July, it is important to specify that any chemical to prevent new infections be applied the next spring since fungicides applied at any other time will be of no use for disease control.

Fourth, recommendations should be made within a range of proper expectations. A good example is of pin oak planted in highly alkaline soil at an institutional site. Years later, the root system has grown out beyond the original root ball and amended soil into the alkaline soil. The tree begins to show symptoms of iron chlorosis, starting with interveinal yellowing (chlorosis). After years of this, the problem becomes more severe, with leaf necrosis (browning) and stem dieback. Everyone begins to notice, and it is agreed that something must be done. Experts are called in and asked for diagnosis and recommendations. With reasonable certainty, buttressed with clear-cut symptoms, as well as soil and foliar analysis tests, iron deficiency is diagnosed.

Recommendations are another matter. There are a lot of possible treatments, ranging from trunk implants of iron to the use of chelated iron fertilizers in the soil to injections of iron in the roots. However, all are problematical relative to a long-term cure of the problem, especially if the situation is severe. If you make it seem like your recommendations are absolute, then you put the grounds maintenance people who have to act on your recommendations in jeopardy of being deemed incompetent once treatments fail.

Finally, always remember that with plant diagnostics, as with human medicine, it is useful to cultivate humility. The first surefire rule of plant diagnostics is — nothing is sure fire.

