Diagnosing Disorders of Trees

Diagnosing tree problems can be difficult. Symptoms and signs can be subtle or only visible using special techniques, important information can be missing, there can be multiple contributing stress agents that make conclusive diagnoses problematic, secondary pests may obscure the primary stress agent, and beginners may lack a familiarity with the common symptoms and signs of biotic and abiotic stress agents common in their area. However, the major difficulty in diagnosing tree health issues is usually not insufficient expertise in forest pathology or entomology; there are many resources available that can assist with the identification of specific pests. Rather, inexperience with proper diagnostic methodology puts beginners at a disadvantage. But diagnosing tree problems can be fun and rewarding if an ordered, scientific approach is utilized and observation skills are practiced and improved. Of course, familiarity with basic forest pathology, entomology, tree physiology, tree anatomy, dendrology, and silviculture are essential to make correct diagnoses.

The following is an ordered approach to tree disorder diagnosis that beginners and experienced foresters alike may find useful. The "Ten S's of Tree Disorder Diagnostics" is a list of information that should be collected and considered every time a diagnosis is undertaken. Careful observation and collection of this information can either lead to a correct diagnosis, or considerably reduce the potential causes of a tree disorder. In some cases, samples must be collected and submitted to a diagnostic lab for additional assistance or definitive confirmation of a diagnosis made in the field. In other instances, careful observation in the field followed by consultation of diagnostic resources such as forest disease and insect texts or forest health websites may be sufficient to identify the causal agent.

*** The Ten S's of Tree Disorder Diagnostics ***

Host Factors

1) ***Species.*** The first diagnostic step should always be the identification of the tree species affected. Many disorders, especially those caused by biotic stress agents such as insects and pathogens, are species specific. In fact, most insects and pathogens a have a very narrow host range, and may be capable of attacking only one or a few tree species or cultivars. Identification of the tree species can effectively eliminate the vast majority of potential insect and disease problems, and narrow the list of suspected agents to a manageable level. Many tree species vary in response to abiotic disorders as well. Familiarity with the specific sensitivities of tree species to abiotic stresses may help narrow the focus of an investigation. Other abiotic disorders are less species specific. In general, if only one tree species (or a number of closely related tree species) is affected while other species are not harmed, it is likely that a biotic stress agent is at work. If many or all tree species in an area are affected, then abiotic causes should be investigated. Familiarity with tree species can also indicate what is normal, and what is abnormal. Often, obvious clues to the stress agent at work are overlooked because they are not recognized as abnormal. Alternatively, significant concern can be generated when the traits of perfectly healthy plants are confused with a disorder.

2) ***Sex.*** Many tree species are ***dioecious***, meaning that they have separate male and female individuals. Even ***monoecious*** species that lack individuals with a specific gender have separate male and female reproductive organs. Examples of dioecious species include ash, maple, sumac, persimmon, holly, cedar, juniper, Osage orange, poplar, willow, and ginkgo. Many tree disorders only affect male or female individuals, or alternatively, only male or female plant parts. At times, determination of tree gender can be difficult, especially when trees are young or dormant. During the growing season, reproductive structures such as flowers, fruits, and cones can indicate the sex of a tree.

3) ***Stock.*** Knowledge of where a plant came from can provide important information when tree health declines. If possible, the seed source, nursery of origin, and provenance should be identified. Many pathogens can be spread in seeds or on seedlings. If a particular nursery or seed source has had a known problem with a specific pest, identification of plantings that used those plant materials can be identified and monitored for health issues. Some landscape nurseries are reputable and produce quality plants for use in ornamental and shade tree situations, but quality control may not be a top priority in others. Familiarity and experience with a nursery and the plant materials provided by them can indicate where potential problems may arise. ***Provenance*** indicates where a plant, or its genes, originated. Subtle variations in a variety of tree characteristics may be present across the large natural ranges of many

tree species. A tree with northern provenance may lack heat and drought tolerance and do poorly when planted at the southern end of the species range. Alternatively, a tree from the south may lack the structural strength to survive ice storms that may be more common in the northern portion of its species range. Therefore, the provenance of a tree may provide important clues as to tree health problems.

4) ***Size.*** Many forest pests only attack trees of a certain size or age, or may only attack certain portions of a tree that meet a size preference. Some insects and pathogens only attack seedlings, while others prefer stands of over-mature timber. Certain insects prefer to attack the lower portion of the main stem, while others attack only the small twigs and branches high in the crown. Many trees species are plagued by pest attacks for their first few years of life, or until they reach a certain height, and then become pest free once a threshold is exceeded. Trees of a certain size may also be exposed to unique microclimates that make them more susceptible to attack. Small trees in dense stands may be suppressed, have poor air circulation to facilitate drying of foliage, are close the ground where spores from many pathogens are produced, etc. Large trees are more prone to lightning strikes and high-winds, and are more likely to suffer severe harm from root injuries. Abiotic disorders such as girdling roots and compartmentalized injury may be present when a tree is planted, but tree health may not decline until the tree has grown for many years.

5) ***Symptoms***. Symptoms are a plant's response to a stress agent and the injury it is causing. Some symptoms are very general and are produced in response to many stress agents, while other symptoms are very specific to certain pests or abiotic disorders. Frequently, unhealthy trees will have more than one symptom. Familiarity with the various types of symptoms and an ability to identify all symptoms present is essential for proper diagnoses. When taken together, a set of symptoms can often indicate the cause of the disorder. Common symptoms include:

Stunting	Galls	Flagging
Chlorosis	Discoloration	Leaf Cupping
Necrosis	Decay	Scorch
Weeping	Lesions	Water Soaking
Dieback	Leaning	Swelling
Wilting	Abnormal Fruiting	Resin Soaking
Defoliation	Callus	Pitch Tubes
Hypotrophy	Sprouting	Foliage Shedding
Hypertrophy	Witches Brooms	Tufting

Stress Agent Factors

6) ***Signs***. Signs are a direct observation of the stress agent itself or evidence of its activity. If a sign can be located and collected, a diagnosis can often be achieved quite readily. However, the presence of a stress agent does not necessarily imply that it is the causal agent responsible for the observed decline in tree health. Many signs on dead or dying trees may be from secondary stress agents that are present only because a predisposing factor or primary pest has already weakened the tree significantly. Some examples of signs are:

Insects	Exoskeletons	Smog
Pupal Cases	Spores	Soil Test Results
Mushrooms	Rhizomorphs	Hardpan
Fruiting Bodies	Charcoal	Frass
Galleries	Tents/Webbing	Egg Niches
Entrance Holes	High Water Marks	Bite Marks
Exit Holes	Wounds	People

Environmental Factors

7) ***Season***. The symptoms and signs of many stress agents appear at specific times of the year. Pests, such as insects and pathogens, have life cycles that are closely tied to host ***phenology,*** which is the timing of plant growth and development throughout the year, and environmental conditions such as light, temperature, and rainfall, which vary by season. Symptoms or signs that may be similar for many different stress agents can be distinguished by the time of year during which those stress agents produce those symptoms or signs. Alternatively, many pests only produce visible life stages at a certain time of year. If a stress agent is suspected, but cannot be verified, a return visit when the suspected pest will be visible can confirm the diagnosis.

8) ***Site***. Site is often a major contributor to forest health issues because many predisposing factors originate from site conditions. There is often a tendency to look only at the tree for symptoms and signs, but close inspection of the surrounding area may reveal the cause of the problem. Both abiotic and biotic components of the surrounding forest may contribute to tree disorders. Some examples of site characteristics to consider include:

Slope	Disturbance	Species Composition
Aspect	Exposure	Alternate Hosts
Soil Characteristics	Light	Climate
Elevation	Strata	Site Preparation
Proximity	Forest Type	Microclimate

9) ***Spread***. Patterns in the distribution of symptoms and trees affected in the landscape can be important indicators of tree disorders. Where and when did the problem start? How fast is it changing (if at all)? Where is the problem most severe? Has the problem disappeared in one area but appeared in another? How many tree species are involved? What else in the landscape follows the same pattern: roads, field edges, elevation, soil type, prevalent wind direction, recent disturbance, management activities? Is the problem randomly distributed or does it follow an organized pattern?

10) ***Stand History***. The history of a forest stand or single tree is often the most important information when diagnosing a tree problem (and often the most difficult to obtain). Stand history may provide important information as to predisposing factors that may have been present in the past. Frequently, tree problems become visible long after the evidence of a predisposing factor has disappeared. In other cases, the stress agent itself may have been noticed and ignored by a landowner or homeowner because it was not recognized as a potential problem. In many cases, detailed knowledge of stand history can provide enough information to significantly narrow the list of potential stress agents. Consider previous crops grown on the site, past root damage, thinning operations, pesticide applications, fertilizer applications, age of the stand, planting method, pruning activity, grade changes, past weather events, fires, and long-term trends in the forest.