Don't Overlook Abiotic Diseases

In the last FNN issue, we discussed scouting tools and techniques and so I'd like to continue with the next step of considering abiotic disease. Nursery workers, and many pathologists as well, tend to overlook or minimize the importance of abiotic diseases or cultural injuries in causing problems. Before we go any further, note that I take the broad view of what constitutes a disease: "any sustained departure from the normal physiological or morphological condition that characterizes a healthy seedling". Therefore, the chlorosis and stunting from nitrogen deficiency is just as much a disease as is the chlorosis and stunting caused by Phytophthora root rot. Other abiotic injuries and cultural problems don't fit the definition, however, as they happen too quickly - for example, frost injury or fertilizer burn.

So, the first step in disease diagnosis is to eliminate abiotic diseases. When they first detect a disease symptom, most people immediately start looking for some critter with the "smoking gun". I guess that it's normal to think that some organism is causing the problem, and of course, it perfectly human to tend to skirt the issue that *you* may be the real pest. Actually, more nursery problems are caused by abiotic diseases than biotic pests **(Figure** 7).

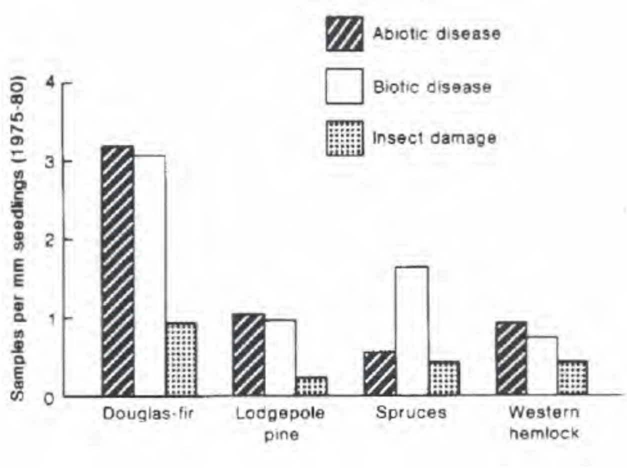

Figure 7. Abiotic diseases are usually more common than diseases or insect pests as shown by these samples received at a British Columbia pest laboratory (modified from Sutherland and others 1982)

Some things to consider during disease diagnosis:

The nursery environment itself predisposes seedlings to abiotic damage. In the nursery business, we try to minimize all the limiting factors that control seedling growth. Like all things in life, however, there are trade-offs and the trade-off for this perfect propagation environment is an increased risk of problems. For example, nursery seedlings are more succulent than naturally-growing seedlings and are therefore at a greater risk of cold injury. This is particularly true for container seedlings grown in greenhouses. Taking the seedling out of its normal environment also upsets the natural balance of things, and the perfect propagation environment is also a perfect breeding ground for many fungi, insects, and other pests. Any pathologist will tell you that common nursery pathogens, such as *Botrytis cinerea,* are rarely seen in native forests.

Secondary pathogens. Another problem that complicates diagnoses is that many fungi quickly colonize injured seedling tissue and these secondary pathogens quickly mask the true cause of the problem. A perfect example is seedling storage diseases. I don't know how many times I've been asked to look at storage molds and sure enough, the seedlings arc completely covered with fungal mycelia. The normal conclusion is that these fungi are pathogenic but they are rarely the true cause of the problem. Most storage molds of bareroot stock are caused by soil contamination. If you have a pathologist culture the suspect fungus they will usually tell you that it is a normal soil fungus, not a typical seedling pathogen. With container seedlings, you will be seeing *Botrytis cinerea* but the predisposing factor is often mechanical injury or climatic damage. If you ask enough questions and get honest answers, you will often discover that the seedlings were damaged by a frost or were not completely dormant and cold hardy when they were packed.

Use all sources of information. When faced with a puzzling abiotic problem, check with other members of the nursery staff who might have noticed something unusual. Consult with other local nurseries to see if they have had similar problems. Check the published literature, and don't overlook older books and journals. Our society continually tells us that what is new is best, but the past is a tremendous source of information. For example, several years ago a bareroot nursery sent me several *Abies* spp. seedlings that had a curious cork-screw curvature to the root system. The nursery manager hadn't noticed anything that could have caused this symptom, so I examined them and found no evidence of pests or environmental injury. Puzzled, I asked

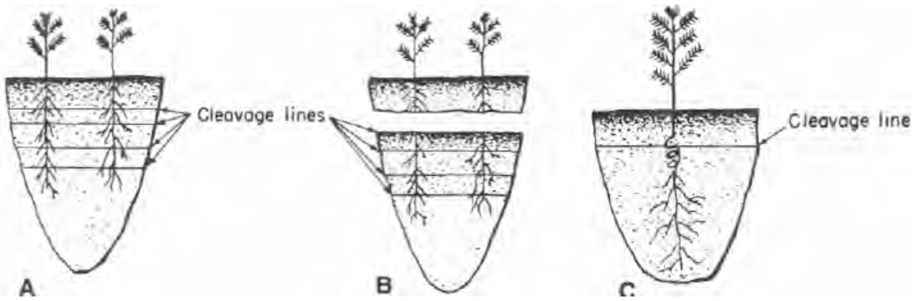

Figure 8 A/B/C - The corkscrew root syndrome. Surface freezing causes cleavage lines to form in the soil of the seedbed (A). Repeated frost heaving lifts the seedlings out of the soil (B), and then subsequent soil thawing lowers them back into place. After this occurs several times during the winter, the seedlings developed a corkscrew or "pigtail" curvature in the lower stem (Arnold 1958).

other nursery pathologists if they had ever seen similar symptoms but nobody had never seen anything like it. As much as I hate to do so, I had to call back the nursery manager and tell him that I just didn't know what had caused the problem. Several years later, however, I was looking through some old issues of Tree Planters' Notes and stumbled onto an article that described the situation perfectly and even had good illustrations **(Figure 8).**

Aids for diagnosing abiotic diseases.

Nursery managers can do a couple of things that will make diagnosing and preventing abiotic problems much easier:

1. **Promote regular scouting.** Try to schedule periodic walks through your nursery and follow a systematic route so that you check all species, seed lots, and locations in the growing area. Bring key members of the nursery staff along such as irrigators, and talk to other workers, such as weeding or thinning crews, to see if they have noticed anything unusual. Ask about any unusual weather or cultural events: was there an unseasonable frost, or did the irrigation boom work properly? When scouting, use all your senses and remember that the most important attribute in disease diagnosis is "the ability to observe accurately."
2. **Keep a daily log.** Taking written notes in a daily journal or log is an excellent way to record climatic and cultural events and also document unusual symptoms that could develop into a disease. This is particularly important for the nursery scout but all members of the crew should be encouraged to jot down anything unusual that they see. In this computer age, we all too often tend to skip some of the simplest and most basic techniques. Keeping a daily journal is a cheap and easy way to gather and document valuable cultural information.
3. **Use growth curves to detect stunting.** Minor growth losses are often the first symptoms of an abiotic problem but they can be very difficult to detect. Taking regular measurements of height, caliper, ovendry weight, and root growth and plotting these growth measurements on graph paper or on the computer will produce a cumulative growth curve that expose minor stunting. And, as you accumulate this information over the years, you will be an generating an invaluable cultural record.
4. **Monitor the weather in the propagation area** Use computer weather systems if you can afford them but at the least, put max/min thermometers and hygrothermographs throughout the nursery and check them regularly. You or your staff can't be around all the time and you know that something weird is going to happen as soon as you leave. Document weather records in your daily log so that you can use them to diagnose potential problems later in the growing season.
5. **Install history plots.** I have advocated the use of history plots in bareroot nurseries for many years, but the same principle can be applied in container nurseries. The basic idea is to establish a series of permanent comparison plots in the nursery so that abnormal growth problems and diseases can be detected early. Since history plots are established at the time of sowing, they can expose problems with poor germination and early growth which may often go unnoticed. Since this is such a complicated subject, I'll discuss history plots in detail in the next issue of FNN.

In conclusion, the take-home lesson is that nursery IPM scouts must always be on the alert for abiotic disorders and realize that Murphy's law applies in spades to nurseries.

Sources:

Arnold, C.A. 1958. Frost damage. Tree Planters' Notes 31: 8-9.

Landis, T.D.; Tinus, R.W.; McDonald, S.E.; Barnett, J.P. 1989. The Biological Component: Nursery Pests and Mycorrhizae, Vol. 5, The Container Tree Nursery Manual. Agric. Handbk. 674. Washington, DC: USDA Forest Service. 171 p.