55. Pesticide Injury

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Hosts

Pesticide injury can occur on all tree species.

Damage

Injury can range from slight cosmetic effects to mortality.

Diagnosis

By maintaining untreated check plots, the nursery manager can determine if seedling injury is due to pesticides (fig. 55.1). Without check plots, diagnosis can be difficult, even for a specialist. Successful diagnosis without check plots requires a thorough knowledge of the employed pesticide's modes of action and experience with injury from inert ingredients, insects, and certain abiotic factors.

Figure 55.1—*Pesticide injury can be easily detected by use of untreated check plots.* Photo by David B. South, Auburn University.

Injury Types

Seedling injury varies with the chemical used; the adjuvant used; inert ingredients; the concentration contacting the seedling; the species, age, and physiological condition of the seedling; the soil texture; the weather; and other environmental considerations. Pesticide damage is most likely to occur when seedling tissue is young and succulent.

Seed

Some chemical seed treatments may inhibit germination. In some nursery trials, the reduction caused by a fungicide seed treatment may be economically significant (for example, 7-percent lower germination) but not statistically significant.

Foliage

Newly formed needles may be burned by inert ingredients like naphtha (fig. 55.2). In some situations, nitrogen fertilization can increase succulence of new tissue, thus increasing susceptibility to injury from certain herbicides. Some managers have observed injury to foliage after fumigating soil with compounds that release methyl isocyanate (MITC).

Roots

Certain herbicides can damage seedling roots. Several dinitroaniline herbicides can injure root systems if the herbicide is incorporated into the soil before sowing. Certain herbicides (for example, sulfurometuron) can also affect the root system when applied to the soil surface. When applied directly to roots after lifting, some fungicides may reduce root growth after transplanting.

Stems

When applied to the soil surface, some dinitroaniline herbicides may cause herbicide galls to form on the stem at the root collar (fig. 55.3). Occasionally, some fungicides (for exaple, dicloran) can also injure stems when applied to newly emerged seedlings.

Growth

Some pesticide injury will be mostly cosmetic (fig. 55.1) and may have little effect on growth. Cosmetic injury may be typical with some pesticides. In some cases, however, growth has been stunted when seedlings are growing in soil containing an herbicide that has a long half-life.

Figure 55.2—*Seedling injury can be caused by ingredients that are incorrectly labeled as "inert." All seedlings in this photo were treated with an insecticide containing naphtha, but only the young seedlings were injured.*
Photo by David B. South, Auburn University.

Figure 55.3—*Herbicide gall on loblolly pine seedling.*
Photo by David B. South, Auburn University.

Reason for Injury

Damage caused by pesticides usually results from one of the following situations.

Misapplication

Injury to a seedling crop is often the result of failure to carefully read the pesticide label. For example, one manager injured pine seedlings when applying a wettable dispersible granule as though it was a granular herbicide. Additional mistakes include failure to properly clean equipment, inadequate herbicide solution mixing, improper equipment calibration, improper application timing, and failure to seek expert advice.

Particle Drift

Particle drift involves airborne droplet movement away from the intended target. The amount of drift is influenced by droplet size, microclimate, chemical formulation, and adjuvants. Nozzle type and size selection is critical. In general, the smaller the spray droplets are, the greater the drift. Hence, when applying pesticides like glyphosate, a coarse spray (large droplets) should be chosen. Thickeners, additives, foaming agents, and emulsifying agents can be added to the solution to affect droplet size and lessen drift.

Vapor Drift

Vapor drift is applied as a solid or liquid to the target site and then a portion moves offsite in a gaseous state. In some cases, this transformation can occur days after the initial application. As a result, some managers do not use certain herbicides (for example, oxadiazon and oxyfluorfen) in greenhouses since they might "lift off" and injure susceptible plants. Also, weather conditions can profoundly influence offsite drift. For example, an inversion layer can suspend and move MITC vapor a considerable distance before contacting sensitive seedlings. To reduce this injury, some experts recommend covering certain soil fumigants (for example, metam-sodium) with a tarp.

Incorrect Formulation

Careful selection of the pesticide formulation can minimize plant damage when the product is applied directly to seedlings. Pesticides formulated as granules or water-dispersible packets are less likely to cause damage than emulsifiable concentrates. Pesticide formulations and adjuvants containing oil can also injure succulent foliage.

Adverse Weather

Temperature, rainfall, inversion layers, and cloud cover can affect pesticide injury. Some pesticides cause damage if applied during hot or dry weather. During heavy rainfall events, some water-soluble herbicides may be carried in surface

runoff and may accumulate in low spots. With certain herbicides, injury may result after high winds that sandblast seedlings (fig. 55.1), especially if the seedlings are less than 2 months old.

Research and education are keys to preventing pesticide injury. Seeking expert advice before applying a pesticide will likely avoid costly injury. When using selective pesticides, well-informed managers can often lower the pest population and minimize the risk of seedling injury.

Selected References

Buzzo, R.J. 2003. Phytotoxicity with metam sodium. In: Riley, L.E.; Dumroese, R.K.; Landis, T.D., tech. coords. National proceedings: forest and conservation nursery associations—2002. Proceedings RMRS-P-28. Ogden, UT: USDA Forest Service, Rocky Mountain Research Station: 79–83.

Callan, N.W. 1979. Dacthal injury on Douglas-fir and true firs at the Medford Forest Nursery. In: Jones, Jr., E.P., ed. Proceedings, 2nd Biennial Southern Silvicultural Research Conference, November 4–5, 1982, Atlanta, GA. GTR-SE-24. Asheville, NC: USDA Forest Service, Southeastern Forest Experiment Station: 418–426.

Fisher, J.W.; Landis, T.D. 1990. Dicloran fungicide causes stem injury to container spruce seedlings. Tree Planters' Notes. 40(1): 39–42.

Landis, T.D. Pesticide phytotoxicity. Chapter 30. In: Hamm, P.B.; Campbell, S.J; Hansen, E.M., eds. Proceedings. Growing healthy seedlings. PNW-019-90. Corvallis, OR: USDA Forest Service, Pacific Northwest Region: 79–83.

Linderman, R.G.; Davis, E.A.; Masters, C.J. 2008. Efficacy of chemical and biological agents to suppress *Fusarium* and *Pythium* damping-off of container-grown Douglas-fir seedlings. Plant Health Progress. doi:10.1094/PHP-2008-0317-02-RS.

Rowan, S.J. 1978. Treflan injury of loblolly pine seedlings. Tree Planters' Notes. 29(3): 25–26.

Samtani, J.B.; Masiunas, J.B.; Applyby, J.E. 2008. Injury on white oak seedlings from herbicide exposure simulating drift. Horticulture Science. 43(7): 2076–2080.

South, D.B. 1980. Nurserymen must leave herbicide check plots. In: Proceedings, 1980 Southern Nursery Conference, September 2–4, 1980, Lake Barkley, KY. Atlanta, GA: USDA Forest Service: 123.

South, D.B.; Hill, T. 2009. Results from six *Pinus taeda* nursery trials with the herbicide pendimethalin in the USA. Southern Forests. 71(3): 179–185.

South, D.B.; Kelley, W.D. 1982. Effects of selected pesticides on short-root development of greenhouse-grown *Pinus taeda* seedlings. Canadian Journal of Forest Research. 12: 29–35.

South, D.B.; Mexal, J.G. 1983. Effect of bifenox and oxyfluorfen on emergence and mortality of loblolly seedlings under growth chamber conditions. In: Jones, Jr., E.P.; ed. Proceedings, 2nd Biennial Southern Silvicultural Research Conference, November 4–5, 1982, Atlanta, GA. GTR-SE-24. Asheville, NC: USDA Forest Service, Southeastern Forest Experiment Station: 418–426.

Taylor, Jr., J.W.; South, D.B. 1989. Pesticide injury. In: Cordell, C.E.; Anderson, R.L.; Hoffard, W.H.; Landis, T.D.; Smith, Jr., R.S.; Toko, H.V., tech. coords. Forest nursery pests. Agriculture Handbook 680. Washington, DC: USDA Forest Service: 159–161.