

Purdue Plant & Pest Diagnostic Laboratory

Diagnosing Herbicide Injury on Garden and Landscape Plants



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Gail Ruhl,
Department of Botany and
Plant Pathology

Fred Whitford,
Purdue Pesticide Programs

Steve Weller and Mike Dana,
Department of Horticulture
and Landscape Architecture

Melodie Putnam, Dan Childs,
and Rosie Lerner were
additional co-authors of the
original 1991 publication.

Herbicides, when used properly, rarely cause problems on nontarget plants. However, these products can cause injury when applied inappropriately, when they turn into a gas (a process called volatilization), or when they are blown by the wind away from the targeted area (a process called drift).

Accurately diagnosing plants that show herbicide injury symptoms is often difficult since, in many cases, other causes may be involved or it may be uncertain what herbicides

were applied. Trained or experienced individuals may be able to tell if a specific herbicide injured a plant. These professionals often examine the plant symptoms and background information (including the type of herbicides used, application rates and timing, injury patterns, and the plant species affected) to confirm or discount the possibility of herbicide injury.

Using chemical analysis to find the cause of herbicide injury only works when the chemical is still present at detectable levels in live plant tissues or



Photo by Janna Beckerman

This grape leaf has been exposed to a growth regulator-type herbicide and shows symptoms of distortion that include rugosity, strapping, curling, and "feathered" edges. Other symptoms (not shown here) may include petiole twisting (epinasty) and leaf cupping.

adjacent soil. Furthermore, such tests are expensive and not available for all herbicides, so it's best to test for specific herbicides in high value crops or in landscape situations where the value of the testing doesn't exceed the value of the plants or crops.

Herbicide Groups

Herbicides can be grouped by the kinds of plants they target, when they are applied, and how they work. Knowing how herbicides work and the symptoms they cause helps to determine whether they might be the source of injury.

Post-emergence Broadleaf Herbicides

Post-emergence broadleaf herbicides selectively kill actively growing broadleaf plants. This includes growth regulator herbicides that have active ingredients such as 2,4-D; 2,4-DP; MCPA; MCPP; dicamba; and others. Herbicides in this group are labeled for use in a number of different locations including homes, farms, and industry.

These herbicides are quite prone to drift and volatilization. Injury symptoms include:

- Twisted leaves
- Downward cupping on leaves
- Narrow, strap-like leaves on the youngest growth
- Aboveground roots on the stems of certain annual flowers

Root uptake of phenoxy materials, especially dicamba, can cause a more serious type of herbicide damage to ornamental plants. Many broadleaf herbicides contain combinations of phenoxy chemicals in the amine salt form. While this form makes the materials less volatile to handle, it also makes them more soluble and more mobile in the soil, so the herbicide can spread to nontarget plants through the soil rather than through the air.

The labels on these herbicides carry warnings against using them near desirable plants. They also warn against spraying the roots of trees and shrubs. That includes warnings to remember the drip lines of ornamentals when spraying turf.

Injury symptoms caused by root uptake of phenoxy materials are similar to those listed above. One notable exception is that dicamba-damaged leaves tend to cup upward instead of downward.

Grass Herbicides

As the name suggests, these herbicides control undesirable grasses. Products in this group include

chemicals that are applied to the soil before weeds emerge (pre-emergence) and chemicals that can be applied after weeds emerge (post-emergence). Pre-emergence herbicides for lawn and garden weed control include products with active ingredients such as venfluralin (Balan[®]), DCPA (Dacthal[®]), and trifluralin (Preen[®]).

Pre-emergence grass herbicides are unlikely to cause drift problems. Some post-emergence herbicides used to control weedy grasses — such as those containing the active ingredients fenoxaprop (Acclaim[®]), sethoxydim (Poast[®]), and fluazifop-P (Fusilade[®]) — may drift and could cause yellowing/bleaching and dieback in the actively growing regions of ornamental grasses.

Nonselective Broad Spectrum and Soil-Applied Herbicides

Herbicides in this group include post-emergence foliar-applied herbicides containing active ingredients such as paraquat (Gramoxone[®]), glufosinate (Finale[®]), and glyphosate (Roundup[®]). Herbicides in this group also include total vegetation killers (sometimes referred to as soil “sterilants”) that contain the active ingredients diuron (Karmex[®], Diuron[®]) and bromacil (Hyvar[®]).

Nontarget plants exposed to these nonselective broad spectrum and soil-applied herbicides may have yellowing foliage, experience dieback, and could eventually die. Soil sterilant-type herbicides are commonly used to control vegetation along highways, railroads, fences, power lines, and similar places. Never use soil sterilants in a landscape setting.

Factors that Affect Spread to Nontarget Plants

Several factors may affect the ability of herbicides to move from the site targeted for application to a nontarget site, including:

- Formulation
- Application method
- Temperature
- Wind
- Soil factors

Formulation

The formulation, or form, of a herbicide's active ingredient determines how it should be applied and its likelihood of causing plant injury. For example, a growth regulator (like 2,4-D) formulated as a low-volatile ester

can vaporize after application and be carried by the wind. However, 2,4-D formulated as an amine is far less likely to vaporize in this manner. And, in general, granular formulations rarely move or volatilize far from the application site.

Application Method

Fine spray droplets have a greater potential to drift from the application site. So, application methods that produce larger droplets are less apt to drift. Use lower pressures or sprayers with large orifice nozzles that will increase the average droplet size and reduce potential herbicide drift problems.

Temperature

High temperatures (above 85°F) during or immediately after application may cause some herbicides to vaporize and, like highly volatile formulations, move to areas outside the site of application. Volatilized herbicides in a vaporized state may still be capable of causing damage.

Prevent volatilization by following label restrictions that deal with temperature.

Wind

Even on seemingly calm days, small wind gusts can move herbicide spray droplets away from the intended site and injure nontarget plants. Larger droplets and spraying closer to target plants can reduce drift. In other cases, winds blowing away from landscape plants will help prevent damage to those plants.

Soil Factors

The amount of soil-applied herbicide a plant's roots can uptake depends on the herbicide, location of the roots in the soil, soil type, and soil moisture. Some herbicides are relatively mobile and will move readily in sandy or porous soils, especially after a rain or irrigation. Other herbicides may not persist long in the soil.

Herbicide labels specify if the product has a potential to move in the soil and injure adjacent plants due to root uptake. Labels provide specific instructions that must be followed.

Herbicide Injury Look-alikes

A variety of factors may cause symptoms that resemble herbicide injuries, including:

- Mite, insect, or disease damage
- Adverse weather
- Soil compaction

- Drought
- Root stress
- Improper soil pH
- Misapplied fertilizers
- Genetic mutations
- Road salt

Generally, one tries to rule out these other factors, leaving herbicides as the only other likely suspect.

Diagnosis

To accurately diagnose herbicide injury, one must know the symptoms produced by particular herbicides on specific plants. Herbicides often show different symptoms depending on the plant injured. Although some resource materials exist (for example, Purdue Extension publication CD-HO-1, *Picture the Damage!*) such information is not readily available for most ornamental plants. In addition, the herbicide's mode of action, its fate in soils, and the dose applied are important in determining if and what herbicide injured the plants.

For example, some herbicides — such as those containing glyphosate (Roundup®, Kleenup®) — become inactive when they become tightly bound to soil particles. This minimizes the possibility of root uptake by nontarget plants. By contrast, tree roots that extend beneath a treated area (such as a lawn) may easily absorb dicamba.

Knowing what other pesticides were applied also is important. We are learning more about unsuspected interactions between herbicides and insecticides, and these interactions should be considered during the diagnostic process.

There are several commercial laboratories that can test for herbicide residues in both plant tissues and soils. However, the herbicide or herbicide group in question must be specified and the cost for analysis is relatively high, ranging from \$65 to \$100 or more per sample. If the herbicide is not known, it is more difficult and expensive to determine the chemical.

The Purdue Plant and Pest Diagnostic Laboratory (P&PDL) does not test tissues or soils for the presence of herbicides. However, you may contact the P&PDL for a list of commercial laboratories that provide this service by calling (765) 494-7071. If you have questions about filing a complaint regarding herbicide injury to your property, contact the Office of the Indiana State Chemist (OISC) at (800) 893-6637.

What to Look For

Timing

Herbicide injuries usually appear within days after exposure, but symptoms may develop several weeks after exposure. Injuries may occur considerably later if tree roots grow into sites that were treated with a soil sterilant within the last two years. This might also be a problem if herbicide-contaminated soil is brought into a landscape site during site establishment.

Adjacent Plants

If you suspect herbicide damage on a specific plant, it is likely that adjacent plants will show similar symptoms within the same time frame. Look for injury on two or more different species. Plants that are sensitive to growth regulator herbicides (broadleaf species) include apple, box elder, dogwood, forsythia, grape, honey locust, horse chestnut, Norway maple, petunia, redbud, rose, tomato, Siberian elm, and sycamore.

It is extremely unlikely that herbicide drift will injure just one tree or shrub in a landscape. You can generally establish a drift pattern by closely observing injury to nontarget plants. Follow the drift from the weeds that are dying in the targeted application area to symptoms occurring on nontarget landscape plants.

Location

It is important to determine the location of injured plants relative to where herbicides were applied. Vaporization or drift of growth regulator herbicides can expose and injure plants away from the site of application; but again, surrounding plants must be examined.

Soil sterilants may move in the soil, but only in the direction of water flow. However, tree roots extend two to three times the length of the longest branches (beyond the dripline), and trees that may seem far removed from the application site may be affected.

Weather records (such as wind direction and speed, relative humidity, and temperature at the time of application), soil type, pH, and site topography can provide valuable information about site conditions that affect the potential for herbicide injury.

Recovery

Whether a plant recovers from nontarget herbicide injury depends on the overall vigor of the affected plant, the amount of herbicide it received, the type of herbicide used, and the growing conditions after contact. Healthy woody plants and many herbaceous plants that receive low doses of a growth regulator herbicide will most likely recover. As the new growth develops it might appear normal.

However, if the plant absorbed a greater dose, the chemical may persist in woody plants (and symptoms may appear for the next two or three seasons) and herbaceous plants can die.

Contact herbicides, such as paraquat or glufosinate, usually cause spotting where spray droplets drift onto and affect leaf tissue. Total tissue death from these herbicides is uncommon unless the herbicide completely covers the leaf tissue. Landscape plants that absorb a soil sterilant may remain stunted and die.

The timing of exposure also affects recovery. Plants that receive an accidental herbicide exposure late in the year when they are preparing to enter dormancy will not be injured as much as plants exposed early in the growing season.

If you suspect herbicide injury, invigorate the tree or shrub with proper fertilizer and water. Such action may help the plant recover. When edible crops have received herbicide drift, the safety of eating these plants is questionable.

Reference to products in this publication is not intended to be an endorsement to the exclusion of others that may be similar. Persons using such products assume responsibility for their use in accordance with current directions of the manufacturer.

