Diagnosing and Preventing Herbicide Injury to Trees

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Herbicides have become an integral part of landscape maintenance because chemical weed control often is more economical and efficient than hand or mechanical cultivation. Chemical weed control also is a primary method of vegetation management in industrial areas, utility rights-of-way, along highways and other non-cropland areas. This increased dependence on herbicides in landscape maintenance has caused concern and confusion among arborists regarding the effects of herbicides on non-target woody plants. Much of this confusion stems from the multitude of herbicides, formulations and products presently on the market. Herbicide injury also is difficult to diagnose based on symptoms alone because other environmental or cultural adversities, as well as infectious diseases and insects, can produce similar symptoms. Detection of herbicide residues by chemical analysis is expensive and often unfeasible.

This report presents a listing of herbicides frequently used in the landscape and their potential toxicity (or lack thereof) to woody plants. A description of herbicide injury symptoms is presented along with suggestions to aid diagnosis and recommendations for remedial treatment of herbicide-injured plants.

TYPES OF HERBICIDES

Pre-Emergence Herbicides For Turf - This group of herbicides is widely used in lawns to prevent growth of annual grasses, such as crabgrasses and certain annual broadleaf weeds. The principal herbicides included in this group are: **DCPA (Dacthal), benslide (Betasan), siduron (Tupesan) and benefin (Balan)**. These herbicides also are mixed with fertilizers to form the so-called "weed and feed" products for turf. Since pre-emergence herbicides for turf have little or no root activity, they are not phytotoxic to woody plants when properly applied.

Pre-Emergence Herbicides For Landscape Plantings - The following herbicides are registered for pre-emergent control of annual weeds around woody ornamentals in the landscape and in commercial nurseries:

Chloramben (Ornamental Weedar)
oxyzalin (Surflan)
dichlobenil (Casoron)
pronamide (Kerb)
diphenamide (Enide)
simazine (Prenceep) (low rates)
napropamide (Devrionol)
trifluralin (Treflan)
oxadizon (Ronstar)

The herbicides generally are not absorbed by roots of woody plants and are safe around most species. Exceptions exist and labels of specific

pre-emergence herbicides should be consulted concerning precautions. Drift contacting the foliage may cause injury on some ornamental species especially if leaves are wet. Some pre-emergence herbicides may cause injury on tolerant woody ornamentals if mis-applied at exceptionally high rates. Injury is usually evident as foliage chlorosis followed by leaf browning and defoliation. Plants usually recover from injury from these herbicides.

Post-Emergence Grass Killers - This group of herbicides is composed of arsonates such as **MSMA and DSMA** which are applied to turf for post-emergent control of crabgrass and other annual grasses. Arsonates are not root-absorbed and are safe around woody vegetation. Drift contacting the foliage of desirable woody plants may cause leaf burn, but injury is confined only to treated foliage. Plants usually refoliate and recover from injury caused by drift from arsenate herbicides.

Post-Emergence Broadleaf Herbicides - The following herbicides selectively kill broadleaf plants but are safe on most grass species: **2, 4-D 2, 4-DP (dichlorprop), MCPP (mecoprop), dicamba (Banvel) and picloram (Tordon). 2,4-D, 2,4-DP and MCPP** commonly are referred to as growth regulator or hormonal type herbicides because their chemistry resembles naturally occurring growth regulators in plants. The hormone herbicides are the most widely used chemicals for broadleaf weed control in turf and are the principal herbicides that are mixed with turf fertilizers to form the "weed and feed" products.

At rates recommended for broadleaf weed control in turf, the hormone herbicides are not root active and their persistence in soil is less than one month. Subsequently, **2,4-D, 2,4-DP, and MCPP** seldom will injure woody plants when applied at their labeled rates for weed control in turf. Granular formulations are safest near trees because there is less likelihood of drift than from spray formulations.

Drift from these herbicides, which contacts the foliage of desirable plants, will cause leaf distortion and browning; however, most woody plants will tolerate the injury and recover. On warm days certain forms (ester formulations) of **2,4-D** may volatilize and cause minor leaf injury when applied near desirable woody plants. Using amine formulations of **2,4-D** minimizes the possibility of injury from volatilization. At high rates, the hormone herbicides are absorbed through the roots of woody plants, which can cause severe injury. Shallow-rooted species and deciduous hardwoods are most sensitive to high rates of the hormone herbicides while conifers are more resistant.

Dicamba and picloram have a different chemistry than the hormone herbicides, but they produce similar injury symptoms. Dicamba is used for controlling hard-to-kill broadleaf weeds in turf and to control woody vegetation in rights-of-way, woodlots, fence lines, and other non-cropland areas. Dicamba is absorbed through the roots of woody plants and can severely injure or kill ornamentals if applied within their root zone. This herbicide is persistent in soil for three months or more and will leach downward in most soil types. The persistence and mobility of dicamba increases the likelihood of the herbicide contacting absorption roots of trees. Injury on woody plants can range from leaf distortion and defoliation to branch dieback and complete death, depending on the rate and frequency of application and the species, age and vigor of the plant.

Picloram (Tordon) is applied primarily for broadleaf weed and brush control in non-cropland such as utility rights-of-way. Picloram is absorbed through the foliage and roots of plants and will severely injure or kill trees if applied within their root zone. At rates applied for brush control, picloram may have a residual effectiveness of a year or more in most soils.

Post-Emergence, Non-Selective (foliar absorbed) Herbicides - This group of herbicides which includes **paraquat, glyphosphate (Round-Up), aminotriazole (Amitrole), and cacodylic acid** controls both broadleaf weeds and grasses. These herbicides are absorbed through the foliage of plants and have little or no root activity. These materials are safe around woody plants as long as drift does not contact the foliage, green bark or suckers of desirable species.

Non-Selective Soil Sterilant Herbicides - Soil sterilants are used for total vegetation control in rights-of-way, pipelines, industrial facilities and other non-cropland areas.

Herbicides included in this group are:

linuron (Lorox)
hexazinone (Velpar)
bromacil (Hyvar)
diuron (Karmex)
tebuthiuron (Spike)
karbutilate (Tandex)
atrazine (Aatrex) (high rates)
prometon (Pramitol)
monuron (Urox)
princep (Simazine) (high rates)

The soil sterilant herbicides are extremely toxic to woody plants and misapplications of this group account for the majority of herbicide-related deaths of landscape plants. Soil sterilants are absorbed readily by tree roots and translocated throughout the crown. Many of these herbicides are water-soluble and may be leached or carried by runoff into the root system of a desirable plant. These materials also have a long residual of a year or more. Subsequently, plants may be injured long after application if roots grow into a treated area or if a tree or shrub is planted in contaminated soil.

Injury and mortality of landscape plants is particularly common when soil sterilants are used for total vegetation control for sidewalks and driveways around homesites before pavement is installed. Soil sterilants often are formulated with other herbicides and sold under a variety of trade names. Homeowners and inexperienced applicators often do not read the labels or comprehend the acute phytotoxicity of these materials.

SYMPTOMS OF INJURY

Symptoms of herbicide injury vary considerably depending primarily on the material applied and the dosage rate. Herbicide injury cannot be diagnosed solely on symptomatology because other adversities can produce a similar effect.

Hormonal (Growth Regulator) Herbicides - **(2,4-D, 2,4-DP, MCPP, dicamba, picloram.**) Symptoms are most pronounced on new growth. Leaf distortion including cupping, curling, abnormal elongation of leaf margins (epinasty) and parallel leaf venation are key symptoms. Current year's shoots may be twisted and flattened rather than round or angular. Leaf necrosis, dieback and mortality may be evident in severe instances especially with dicamba and picloram. Late spring frosts may cause leaf and twig distortions similar to injury by growth-regulator herbicides.

*Triazine Herbicides (**simazine, prometon, atrazine**)* - The initial symptom is chlorosis of leaf blade between the veins. Leaf browning, dieback and death may follow. Nutrient deficiencies, air pollution injury, and sucking insects may produce leaf chlorosis similar to triazine herbicide injury.

*Contact Herbicides (**glyphosphate, paraquat, cacodylic acid**)* - Light drift may appear as small, brown spots where droplets contacted the foliage. Leaf browning and dieback usually is restricted to treated areas of the plants. Foliage, such as root suckers, accidentally treated late in the growing season may cause severe crown-dieback the following year, especially on shrubs and small trees.

Amino-traizole causes severe chlorosis and may bleach treated foliage white. Amitrole may be translocated to untreated portions of the plant where similar symptoms are evident. In severe instances, dieback and decline may result.

*Urea and Uracil Herbicides (Soil Sterilants: **bromacil, tebuthiuron, diuron, monuron, karbutilate, linuron**)* - Initial symptoms are chlorosis of leaf blades and/or veins. Necrosis of the leaves progresses from the margin. Branch dieback and mortality usually follows. Other factors, which can produce leaf browning, and dieback similar to injury from soil sterilants include natural gas, lightning strikes, deicing salts, winter drying, transplanting shock and infectious diseases.

DIAGNOSIS

Before making a diagnosis, the arborist must have full knowledge of the appearance of the healthy plant. Many ornamental plant varieties are selected for yellow or white variegation in the leaves, which could be mistaken for herbicide injury if the arborist is unfamiliar with the plant. Some varieties also are selected for contorted foliage and stems such as the fantail and corkscrew willow, contorted white pine and contorted European filbert.
These varieties could be mistaken for hormone-type herbicide injury by the unsuspecting arborist.

Diagnosis of herbicide injury requires careful observations and detailed questioning of property owners. If herbicide injury is suspected, check the weeds in the lawn and other near-by vegetation for similar symptoms. Herbicides usually produce the same symptoms on a wide range of plant species, which is unusual for other causal agents. If injury symptoms are widely present, check for the source of the herbicide such as the lawn, rights-of-way, industrial area, fence line or highway. Question the property owner or applicator as to the type of herbicide applied, the rate and application method. Often the herbicide container must be inspected because the applicator is unfamiliar with the material or the exact rate of application. Also remember that herbicide injury may result from applying insecticides or fungicides to desirable plants using an herbicide-contaminated sprayer.

If a root-active herbicide such as **dicamba** or soil sterilant material was applied, consider the fact that tree roots typically extend far beyond the dripline. Recent research has shown that absorption roots may extend more than two times the height of the tree from the trunk. Tree roots may absorb an herbicide even if the material was applied outside the dripline of the plant. Soil sterilant herbicides also have long residual activity and most are water-soluble. Subsequently, these materials may leach into the root zone of a desirable plant long after they were applied. Phytotoxicity also may occur when planting in herbicide-contaminated soil.

REMEDIAL TREATMENT OF HERBICIDE INJURED TREES

Trees usually recover from light herbicide injury. Irrigating the plant during dry periods will minimize moisture stress, which may hinder recovery.

Irrigation also will help leach root-active herbicides from the root zone of the plant. Fertilization should be avoided for a minimum of one growing season following injury, because stimulating excess growth can compound injury from certain herbicides. Similarly, if branch dieback results, pruning should be delayed for a least a year to fully assess the extent of the injury. This will avoid additional pruning of dead branches that may result from continued decline. However, immediate pruning is necessary if dead branches pose a danger to life or property.

If root active chemicals such as **dicamba**, high rates of **2,4-D** or **soil sterilants** are applied near trees, activated charcoal may help tie-up herbicide residues and minimize injury. Activated charcoal must be applied immediately following the mis-application of the herbicide, preferably before the onset of symptoms. If tree roots absorb the herbicide and damage becomes evident, activated charcoal will be of little value in ensuring survival of the affected plant.

Activated charcoal is applied at 150 times the amount of the active ingredient per acre of the applied herbicide. For example, if four pounds active ingredient of an herbicide were applied per acre, then 4 X 150 or 600 pounds of activated charcoal per acre would be necessary to deactivate the residue. For best results, charcoal should be soil incorporated by tilling it into the upper three to four inches of soil, or by

mixing with water and injecting it as slurry using a high volume sprayer.

Trees, which are seriously declining from herbicides generally, do not recover and removal usually is required. Trees should be left standing for at least one growing season after the damage has occurred to fully assess the potential for recovery. Replanting the site should be attempted only after herbicide residues have degraded.