Interpreting Herbicide Damage in the Nursery

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Pesticides play a major role in nursery production, landscape plantings, and other agricultural commodities whether we agree with their use or not. In nursery production, pesticides can optimize plant growth by controlling certain diseases, insects, weeds. The majority of pesticides used in agriculture belong to 1 of 3 groups: insecticides, fungicides, and herbicides.

Most wholesale nurseries, landscape professionals, and row crop farmers rely on herbicides to effectively control weeds. When herbicides are used correctly, they can be an extremely valuable tool for weed control, saving the producer time and money. However, when herbicides are used incorrectly or carelessly, catastrophic damage can occur to desirable plants. The symptoms of herbicide damage can vary greatly and they depend on many factors such as what chemical was sprayed (and its MOA), wind speed and direction, temperature, humidity, and species of plant affected.

2015 was a particularly bad year for herbicide damage at middle Tennessee nurseries for reasons still unknown. From late April through June, a wide range of herbicide damage symptoms were reported. Some of the reoccurring herbicide damage symptoms included leaf defoliation, axillary bud proliferation, leaf chlorosis, and deformed leaves and shoots. From these symptoms alone, it can be difficult to rule herbicides as the cause of damage because some plant diseases, insects, mites, and other abiotic (non-living) factors can cause similar symptoms. After

visiting the nurseries and examining the symptomatic plants, three observations stood out: 1) The majority of affected plants were near a corn or soybean field, 2) Damage to large trees and shrubs was more severe on the side facing the corn or soybean field (**Image 1**), and 3) Symptoms became more severe as one moved towards the corn or soybean field.

For farmers planting corn, soybeans, or other row crops, it is common practice to apply a broad spectrum, post-emergent herbicide to kill all existing weeds. Glyphosate (Round-Up) is the most commonly used broad spectrum herbicide and it kills plants by inhibiting an essential amino acid found only in plants. For farmers producing hay and forage, 2,4-D is the most common herbicide used to control broadleaf weeds. Although glyphosate is effective at killing the majority of herbaceous weeds, Tennessee hosts at least 6 weed species known to be resistant including marestail, palmer amaranth, common ragweed, and giant ragweed. As a result of glyphosate resistance in these weeds, another herbicide with a different MOA must be used to control these weeds.

Phenoxy-based herbicides such as 2,4-D are generally effective at controlling broadleaf glyphosate resistant weeds. Phenoxy-based herbicides mimic Auxins, a naturally occurring plant growth regulator (PGR) found in all plants. Auxins are responsible for normal plant growth and development but when auxin levels are too high, uncontrolled growth will occur. Spraying a synthetic auxin on a broadleaf plant will flood the plant's cells with this PGR mimic and the plant will literally grow itself to death.

The molecular structure of these phenoxy-based herbicides makes them an effective broadleaf herbicide but it also makes them volatile, readily drifting off site as a gas. These herbicides are usually formulated as an amine or ester. Amine formulations are more water

soluble and less likely to volatize, while ester formulations are more readily absorbed by the plant and more volatile. Warmer temperatures in excess of 85 degrees Fahrenheit and high soil moisture content increase the volatilization risk of both formulations.

Other temperature sensitive herbicides used by farmers include Dicamba and saflufenacil. Saflufenacil inhibits chlorophyll biosynthesis in plant cells which results in a buildup of hydrogen peroxide. Hydrogen peroxide is an extremely reactive compound causing cell membranes to disintegrate and the content of the cell to leak out.

When investigating plants with suspected phenoxy-based herbicide damage, it's important to take into account the weather conditions the day the spraying occurred as well as the weather conditions the following few days. It's also important to note the affected plant species and their location in the nursery, the damage symptoms observed, and the specific herbicide(s) sprayed. Because phenoxy-based herbicides cause uncontrolled growth, symptoms are seen as looping and kinking growth (**Image 2**). Phenoxy-based herbicides can also stunt and disfigure young leaves (**Image 4**).

Glyphosate is so commonly sprayed in nursery and agriculture settings that occasionally, accidents happen. Although glyphosate is not volatile like phenoxy-based herbicides, damage can still occur from direct liquid spray contact and careless application practices. In cases where glyphosate spray drift has directly contacted woody ornamentals, bud proliferation (**Image 5**), leaf abscission, and chlorotic growth (**Image 6 and 7**) has resulted. Studies have shown that glyphosate is taken up less efficiently and processed differently by hardwood plants than herbaceous plants (Green et al. and D'Anieri et al.). For this reason, glyphosate damage to woody ornamentals may not appear for several weeks after the initial spray drift occurred.

If you suspect herbicide damage, it is important to take immediate action because chemicals are continuously degraded by the environment and metabolized by the plant. First, gather plant material and send it to a laboratory that will test for herbicide residue. Put the plant material into a sealed plastic bag and place it into a refrigerator until the sample can be mailed. Second, take pictures of the damage and make detailed notes including the dates symptoms were first observed, affected plant species, location within the nursery or landscape, and any other observation should the case need to be settled in a court. If a neighbor is actively spraying during a windy day hang a few towels or sheets around the perimeter of the nursery. This clothesline might look odd and out of place but the towels and sheets can also be collected and tested for herbicide residue.

In areas where agriculture and nursery fields overlap, producers should be aware of the effects herbicide volatilization and drift will have on neighboring crops and the environment. By taking steps such as getting to know what crops you neighbors are growing, setting sprayers to produce larger droplets (by reducing psi), and not spraying on windy or hot and humid days, the chance for herbicide drift will be minimized. Herbicides are useful and valuable tools for both the green industry and agriculture, so practicing safe and responsible spraying methods will benefit all involved.

Image 6.

This young fruit tree is experiencing chlorotic new as the result of glyphosate spray drift.

Image 3.

Rapidly growing broadleaf plants like this tree of heaven (*Ailanthus altissima*) can be excellent indicator species when diagnosing phynoxy-based herbicides as the major cause of damage.

Image 5.

Heavy spray drift from a Glyphosate-based herbicide has caused these *Zelcova* buds to proliferate into a mass of new buds. In cases this severe, the tree will probably not survive.

Image 4.

Redbuds (*Cercis* sp.) and other fast growing broadleaf plants are extremely sensitive to phynoxy-based herbicides. Even when trees are located hundreds of feet away from the source of herbicide drift, newly developing leaves and shoots can become stunted and disfigured. Note the wavy leaf margins and nearly parallel veins of the leaf.

Image 1.

In windy conditions, herbicide damage is often confined to only one side of the plant. These dwarf burning bushes clearly illustrate the direction of the spray drift.

Image 2.

Phenoxy-based herbicides kill broadleaf plants by causing uncontrolled growth. The uncontrolled growth often kinks, twists, and knots up on itself.

Image 7.

This side shoot of *Clethra alnifolia* has become yellow in response to receiving spray drift from a glyphosate-based product.