Interpreting Herbicide Damage in the Nursery

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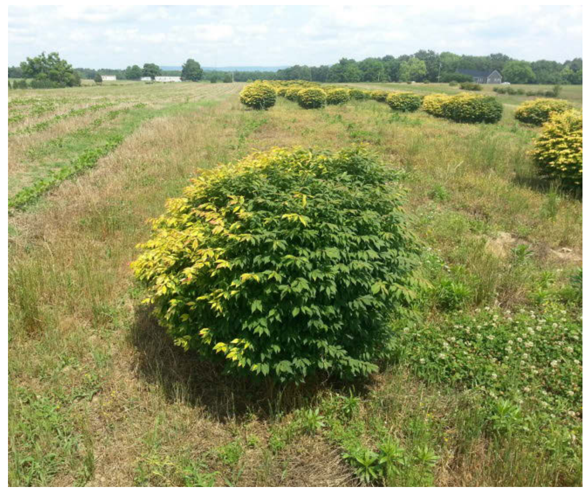
Herbicides are an important tool to help wholesale nursery growers, landscape professionals, and row crop farmers control weeds effectively. When herbicide products are used correctly, they can save both time and money. When herbicides are used incorrectly or without regard for nearby plantings, however, catastrophic plant damage called phytotoxicity, may result. Symptoms of herbicide damage can vary greatly and are influenced by factors including type of chemical sprayed, the active ingredient mode of action (MOA), interaction with adjuvants, wind speed, wind direction, air temperature, humidity, and species or cultivar of plant affected.

Middle Tennessee nurseries observed considerable herbicide injury to ornamental plant crops between April and June in 2015. Some re-occurring herbicide damage symptoms included leaf defoliation, axillary bud proliferation, leaf chlorosis, and deformed leaves and shoots. Diagnosing an herbicidal cause from these symptoms alone can be difficult because some plant diseases, insects, mites, and other abiotic (non-living) factors may cause similar symptoms. After visiting several nurseries and examining the symptomatic plants, three observations stood out: affected plants were frequently in near proximity to a corn or soybean field and damage to large trees and shrubs was more severe on the side facing the corn or soybean field (**Image 1**). Symptoms on affected crops were often more severe among specimens planted closer to the corn or soybean field.



▲ **Image 1**
When conditions are windy, herbicide damage is often confined to only one side of the tree or shrub.

Farmers who plant corn, soybeans, and other row crops commonly apply a broad spectrum, post-emergent (POST) herbicide prior to planting to kill all existing weeds. Glyphosate (Round-Up) is one of the most commonly used broad-spectrum POST-herbicides and kills plants by inhibiting an essential amino acid found only in plants. Although glyphosate is effective at killing the majority of herbaceous weeds, Tennessee hosts 7 weed species known to be glyphosate-resistant including horseweed, Palmer amaranth, giant ragweed, goosegrass, tall waterhemp, annual bluegrass, and Italian ryegrass (Heap, I. 2015). As a result of glyphosate resistance in these weeds, a different POST-herbicide with a different MOA must be used to control these weeds.

▲ **Image 2**
Phenoxy-based herbicides kill broadleaf plants by causing uncontrolled growth. The uncontrolled growth often kinks, twists, and knots up on itself.

Glyphosate is so commonly sprayed across landscape, nursery, and agriculture settings that accidents happen. Although glyphosate is not volatile like phenoxy-based herbicides (*see below*), damage can still occur following drift and direct liquid spray contact to crop foliage and plant suckers, as well as careless application practices. In cases where glyphosate has directly contacted woody ornamental plant tissue, bud proliferation (**Image 5**), leaf abscission, and chlorotic new growth (**Image 6 and 7**) have resulted. In woody plants, glyphosate uptake occurs less efficiently and is metabolized differently than in herbaceous plants (D'Anieri et al. 1990) and (Green et al. 1992). For this reason, glyphosate damage to woody ornamentals may not appear for several weeks following the initial spray drift occurrence.

▲ **Image 3**
Rapidly growing broadleaf plants like this tree of heaven (*Ailanthus altissima*) can be excellent indicator species when diagnosing phenoxy-based herbicides as the major cause of damage.

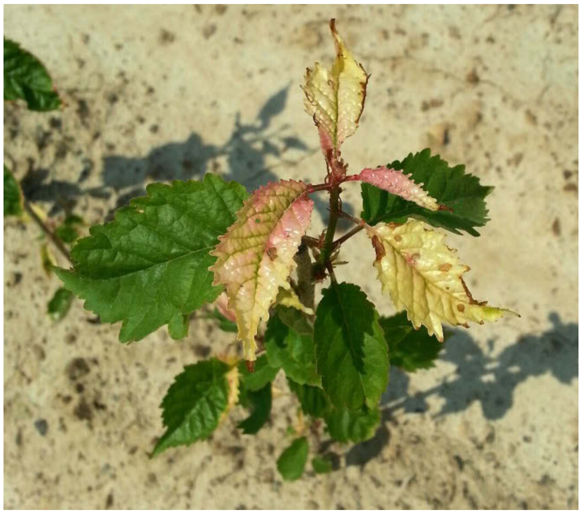
Farmers producing hay and forage commonly use phenoxy-based herbicides like 2,4-D to control broadleaf weeds including those weeds that are resistant to glyphosate. Phenoxy-based herbicides mimic auxin, which are naturally occurring plant growth regulators (PGR) found in plants. At normal levels, plant-derived auxins yield normal plant growth and development. When auxin levels are elevated, for example by treatment with synthetic herbicide derivatives, uncontrolled cellular growth will occur. In essence, spraying a synthetic auxin on a broadleaf plant flood the cells with a PGR mimic causing the plant to "grow itself to death" by exhausting energy resources. Resulting uncontrolled growth yields symptoms in affected plants including contorted and kinked growth of stems (**Image 2**) and stunted or disfigured new leaves (**Image 3** and **4**).

▲ **Image 4**
Redbuds (*Cercis* spp.) and many other fast growing broadleaf trees are extremely sensitive to phenoxy-based herbicides. Even when trees are located hundreds of feet away from the source of drift, developing leaves can become stunted and disfigured. Note the fan-shape and wavy leaf margins.

The molecular structure of these phenoxy-based herbicides also makes many of them volatile, and in a gaseous form, can readily drift off-site, leading to phytotoxicity symptoms. Phenoxy-based herbicides are usually synthesized as an amine or ester formulation. Amine formulations are more water soluble and less likely to volatize, while ester formulations are more readily absorbed by the plant and more subject to volatility. Regardless, air temperatures that exceed 85 degrees Fahrenheit increases the volatilization risk of both formulations, particularly when paired with high soil moisture content. 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.

▲ **Image 5**
Heavy spray drift from a glyphosate-based herbicide has caused the buds on this Zelkova to proliferate into a mass of deformed growth. In cases this severe, the tree will probably not survive.

If you suspect herbicide damage to ornamental plants or crops, 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 (not the freezer) until the sample can be mailed. Samples should be mailed early in the week to avoid sample decline across weekends. Second, take pictures of the plants, foliage, surrounding area, and make detailed notes including the date symptoms were first observed. Also note affected plant species, cultivar, their location within the nursery or landscape, weather conditions, and other relevant observations 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 but the towels and sheets can also be collected and tested for herbicide residue.



▲ **Image 6**
This young fruit tree is experiencing chlorotic new growth in response to receiving spray drift from a glyphosate-based herbicide.

In areas where agriculture and nursery fields overlap, producers should be aware of the effects herbicide volatilization and spray drift can have on neighboring

▲ **Image 7**
This *Clethra alnifolia* foliage has become chlorotic in response to receiving spray drift from a glyphosate-based product.

crops and plants. 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.

References:

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