



Herbicides

Herbicides are designed to kill unwanted plants. They can be a useful tool when used correctly. On the other hand, when herbicides are misused, the results can be harmful to the environment, non-target organisms (such as landscape plants), and human health. By understanding more about herbicides, we can make better informed decisions about whether or not to use them.

A weed is any plant that interferes with the management objectives for an area of land at a particular time. Most of us just think of weeds as unwanted plants. Some weeds are nothing more than a nuisance. However, weeds can also invade native ecosystems, affect human and/or animal health, and be incredibly difficult to control. Herbicides should be used in conjunction with mowing, pulling, grazing, and other techniques to create an integrated approach to weed management.

Whether or not you use an herbicide to control weeds is your decision. Whatever you decide, you should always correctly identify the weed species before trying to manage it. Identification will help you to identify weed management strategies that are effective and whether or not a given herbicide could be effective. Whether a plant is an annual, a perennial or woody species can determine which herbicide is the best choice for a given situation. You should always read the label of any product before purchasing it.

While there are numerous synthetic or conventional herbicides on the market, consumers are becoming more interested in using “least toxic” products, as they are less toxic to people, pets, wildlife and other non-target organisms. “Least-toxic” does not mean non-toxic.

Pre-emergent vs Post-emergent

Herbicides contain active ingredients that kill unwanted plants and can be separated into two main categories: pre-emergent and post-emergent.

Pre-emergent herbicides prevent plant seedlings from becoming established. They often work by inhibiting some important cellular function such as cell division, cell wall formation, lipid synthesis, amino acid synthesis, or photosynthesis.

Pre-emergent herbicides are commonly used on commercial landscapes where there is lots of bare ground. They require close attention to timing and application rate to be effective. Many homeowners contract professionals to apply pre-emergent herbicides in their landscapes.

The only least-toxic product marketed as a preemergent herbicide this author is aware of is corn gluten meal (CGM), a waste product of corn syrup processing. CGM works by allowing the seed to germinate then be desiccated (physically dried out) by the CGM on the soil surface. If the soil never dries out, the CGM acts as a fertilizer (it has 10% nitrogen) and can cause weeds and crop plants to respond with increased growth. CGM is an ineffective preemergent herbicide under most conditions.

Post-emergent herbicides kill growing weeds, but most will not prevent weed seeds from germinating. Post-emergent herbicides have similar modes of action to pre-emergent herbicides. Many are designed to target enzyme systems or metabolic processes that exist in plants but not animals. Post-emergent herbicides can be further divided into two categories: selective and non-selective. **Selective herbicides** affect only certain types of plants (i.e. broadleaves or grasses). Conversely, **non-selective herbicides** such as glyphosate and glufosinate enter plants through the foliage and will kill all types of plants. They do not persist in the soil. These herbicides are most effective when plants are actively growing and can be useful for lawn renovations, xeriscape areas, rock gardens, or on weeds that come up in sidewalk cracks. They may require multiple applications for effective weed control.

Contact vs Translocated (Systemic) Herbicides

Foliar applied herbicides fall into two general categories: contact and translocated (systemic). **Contact herbicides** kill only green tissue contacted by the spray. **Translocated herbicides** move within the plant from point of application to other plant parts. Product labels provide extensive guidelines to help you reach targeted control. Specific herbicide information follows listing products by trade name with common names italicized in parentheses. All of these products must be used in accordance with the label for desired results.

Post-emergent product examples:

Reward (*diquat*) is a synthetic contact herbicide. It has best results when used on small annual weeds. Large annuals and perennials will be injured but not killed. Spray drift causes minimal damage to non-target weeds. Reward works well in hot or cool weather. However, it has a relatively high mammalian toxicity.

Scythe (*pelargonic acid—fatty acid found in seeds and foods*) similar in chemical makeup to soap, is a least-toxic contact herbicide that is most effective against small, annual weeds. It will not kill large annuals and perennials. In cold weather Scythe is not as effective as conventional alternatives such as diquat. Advantages include lower mammalian toxicity and very rapid symptom development. It also has an odor that some people may find offensive.

BurnOut II (*citric acid and clove oil*) is a least-toxic contact herbicide which is most effective on annual weeds, but can be repeatedly applied to control some perennials.

Roundup-Pro (*glyphosate*) is a translocated synthetic herbicide which kills annual and perennial weeds. Roundup-Pro has low mammalian toxicity and no residual soil activity. Be patient when using Roundup. Weeds often do not display symptoms of death for seven days or more. Spray drift can severely injure non-target plants, so use care when applying. Roundup-Pro, contains an adjuvant giving it a lower dermal toxicity, enhanced absorption, and improved resistance to being washed off by rain. With the improved absorption, Roundup-Pro now has a greater potential for injuring conifers.

Finale (*glufosinate-ammonium*) is a translocated synthetic herbicide. It is similar to Roundup-Pro in its mode of action. Finale acts on weeds more rapidly: often within 48 hours. It is less efficient at killing perennial weeds such as field bindweed. Mammalian toxicity is moderate. Finale works well on annual weeds that are moderately difficult to control (purslane, foxtail, tumbleweed, etc.).

Of all the products listed above, products containing glyphosate are probably the most versatile. Glyphosate kills many of our most difficult-to-control weeds including bermudagrass, johnsongrass, and nutsedge. For bermudagrass and johnsongrass, the most effective time to treat is when they first flower. Nutsedge is most effectively controlled during early summer and as it appears.

Glyphosate is a widely used herbicide used to manage perennial weeds in residential and agricultural settings. Toxicologists at the Environmental Protection Agency (EPA) agree that glyphosate is safe for homeowner use and has a low toxicity for humans. Once glyphosate is applied and taken up by the plant, any remaining pesticide residue is rapidly degraded by bacteria in the soil. Glyphosate alone has no residual soil activity and consumers that use it usually obtain desirable results.

Glyphosate has been vilified by some for its widespread use in agriculture and the genetic modification of crops bred to be resistant to it. This is an entirely different situation and should be viewed a separate issue than glyphosate's use in landscapes. Keep in mind that the small amounts and intermittent applications used in landscapes manifest a much lower risk than amounts and frequency used in production agriculture. The current state of the science is that glyphosate can be safely used by homeowners to manage perennial weeds.

Vinegar (acetic acid) is no longer recommended as a least-toxic post-emergent herbicide. Grocery store vinegar is 5% acetic acid. 5-7% acetic acid formulations were marketed as herbicides but were not effective. Concentrations over 11% can cause burns upon skin contact. Eye contact can result in severe burns and permanent corneal injury. Because the public is used to thinking of vinegar as something you can safely splash on your salad and eat, they are generally unaware of potential dangers of higher concentrations.

Homeowners that want to maintain bare ground will need to spot spray with an appropriate herbicide and apply pre-emergent herbicides twice per year (fall and spring). The other option is to develop a drought-tolerant plant community that will resist weeds. Where water, soil, and plant nutrients are present, plants will try to grow. Why not select drought-tolerant grasses and native forbs that will occupy the space and not require constant inputs of herbicides?

Plant Dieback, Non-typical growth, Plant Decline

Landscape plant growth problems are often related to herbicides containing glyphosate in combination with imazapic or imazapyr. These non-selective ingredients are combined to produce longer lasting results, and are used to manage a broad range of weeds in aquatic and terrestrial environments. In aquatic ecosystems, the imazapyr/imazapic is quickly degraded by sunlight. In soil, however, the active ingredient may persist for as much as one year. In alkaline soils (found in most of Arizona and the western U.S.), imazapic and imazapyr do not bind to soil, can easily be moved by water flowing through the soil, and can be absorbed by plant roots that happen to be in the vicinity. This results in the undesirable symptoms and plant losses. In most cases, homeowners use these products to manage weeds on gravel driveways or bare ground/decomposed granite landscaped areas planted with trees and woody shrubs.

Symptoms of imazapic/imazapyr injury on ornamental plants include: abnormal, tufted growth that never elongates (called witches broom); "strappy" or twisted new growth; defoliation; and death. Different plant genera may display slightly different symptoms, but symptoms are often found on several unrelated plant species in the landscape.

Labels of these formulations clearly state that nearby plants may be injured if applied near desirable plant root systems and that water can transport the herbicide downslope. All registered pesticides must have an ingredient statement on the label which displays the active ingredients contained therein. If you see imazapic/imazapyr on the label, you might want to reconsider using it. It is risky to use these products in residential landscapes.



Waxleaf privet (*Ligustrum japonicum* 'Texanum') damaged by imazapyr showing "tufted growth" (photo by Cooperative Extension client).



Red tip photinia (*Photinia fraserii*) showing normal growth on left and foliage slightly damaged by imazapyr



Raywood ash (*Fraxinus oxycarpa* 'Raywood') possibly damaged by imazapyr showing "witches brooms" with normal looking Raywood ash in the center background (photo by Jeff Schalau, University of Arizona).

Naming of products is neither meant to imply endorsement by the University of Arizona nor criticism of similar products not mentioned.

Additional Resources:

[ADOT's guidelines are to not spray herbicides with winds over 10mph](#)

[Weed Management in the Landscape](#) University of Arizona

[Herbicide Damage to Woody Plants](#), University of Florida/IFAS Extension

[Roundup is Roundup...Right?](#), Colorado State University Extension, CO-Horts Blog

[Using Herbicides Safely Around Trees](#), University of California Agriculture and Natural Resources

[Acetolactate Synthase \(ALS\) Inhibitors](#), North Carolina State University Extension

[Common Landscape Herbicides and Their Effects on Trees](#), Mississippi State University Extension

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