



One Herbicide Mix to Do It All (Almost)

Using a mixture of the herbicides glyphosate plus triclopyr provides a broadly effective and low-risk treatment for invasive plant species

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Spot-treatment of invasive species is an effective management approach. Photo by Art Gover

OK, a single herbicide mix will not address every weed management situation. However, a mixture of the herbicides glyphosate and triclopyr can address most invasive plant species issues, particularly if you are foliar spot-treating target weeds (Figure 1). This article will provide details showing this mixture is effective, versatile, and poses minimal risk to non-target organisms.

Herbicide Mix Objectives

An effective herbicide mixture increases the species control spectrum and utility over the individual ingredients used alone. An ideal mix for invasive species management would effectively control all targets you encounter so that you don't have to make multiple passes through an area.

An effective mix also provides flexibility through a wide application timing window, as well as location within the landscape. Herbicides with restrictions for use near water, or limited site-use labeling limit utility.

Another consideration is potential non-target impact, whether the non-targets are plants or other organisms. Herbicides with significant soil activity may cause unintended effects on non-target plants through root absorption, or prevent revegetation of treated areas after treatment. Herbicide active ingredients are in general only active against plants at labeled use rates. However, a formulated herbicide product is a complex mixture of many ingredients, and sometimes the inert (non-herbicide) ingredients can impact non-targets. For example, laboratory investigations have demonstrated negative effects of surfactants to arthropods through surface exposure and ingestion, and some surfactants have demonstrated acute toxicity to tadpoles at use rates (as opposed to high-dose toxicology investigations).

A final consideration is cost and availability. Is the mixture economical on a per-acre basis, and are the ingredients readily available in useful container sizes?



Glyphosate plus Triclopyr

The combination of the herbicides glyphosate and triclopyr satisfies the objectives for an herbicide mixture, providing a wide control spectrum and timing window, minimal non-target impacts, and the ingredients are readily obtained and easy to use. The recommended rates are glyphosate at 3 pounds per acre plus triclopyr at 2 pounds per acre, on an acid equivalent basis. "Acid Equivalent" is the very fine print at the bottom of the ingredients table on an herbicide label. Use acid equivalent to compare products, as "active ingredient" can cloud the issue when comparing different formulations. Product rate will vary, as both herbicides are available in different formulations with different concentrations. Mixing to apply a specific dosage requires sprayer calibration. For details refer to Penn State Extension backpack sprayer calibration article "Backpack Sprayer Calibration for Woodland Applications".

Glyphosate is a non-selective herbicide with no soil activity that can be applied to foliage or cut surfaces of woody stems. Glyphosate has a very broad spectrum, controls most treated plants, and at least injures almost any plant species treated. Triclopyr is a selective herbicide that affects "broadleaf" plants, with minimal soil activity that also can be applied to foliage and woody stems. The combination is non-selective, and best used in settings where target plants can be selectively spot-treated to preserve desirable plants (Figure 1). The activity spectrum of the glyphosate plus triclopyr mixture is additive, as the combined control spectrum is greater, and there are no known instances of the combination being less effective on a target species than the individual ingredients. Used alone, glyphosate is ineffective against autumn olive and Oriental bittersweet. Triclopyr alone is ineffective against shrub honeysuckles. The combination of glyphosate and triclopyr provides effective control of all these species. Observations to date indicate no antagonism between these herbicides, as control with glyphosate of Japanese knotweed, reed canarygrass, or common reed (*Phragmites*) is not reduced with the addition of triclopyr.

By choosing aquatic-labeled products, including the surfactant, the combination of glyphosate and triclopyr can be used on the full spectrum of non-crop and forestry sites, to the edge of open water. Please remember that applications to vegetation emerging from open water require a site-specific permit (in Pennsylvania).

Because this combination is non-selective, any vegetation contacted by the spray will be injured. In other respects, this mixture poses minimal non-target injury risk. Soil activity is minimal, so non-target plants will not be injured through root absorption, and treated sites will revegetate from the seed bank. Inadvertent (or intentional) contact with aquatic systems will not negatively impact aquatic fauna, vertebrate or invertebrate, and both herbicides have the lowest level of toxicity, "Relatively nontoxic" to honeybees.

Both glyphosate and triclopyr are easy to acquire. Aquatic-labeled products will likely need to be shipped as they are not commonly inventoried at "farm stores". However, a number of companies carry them, and there are multiple products from which to choose. Commonly available packaging is convenient to users treating relatively small acreages, as the common 2.5-gallon container size of either herbicide will treat 3 to 5 acres, and shelf life is several years in proper storage (no freezing). Using 2020 pricing, material cost for a treated acre will be approximately \$65.

Glyphosate Products

There are a number of aquatic-labeled glyphosate products. The most common are surfactant-free, with 4.0 pounds of glyphosate-acid per gallon. The ingredients will be 54 percent by weight of the isopropylamine salt of glyphosate. Product examples include (but not limited to) "Rodeo", "AquaNeat", "AquaPro", "AquaStar", "Glyphosate 5.4", and "Roundup Custom".

An advantage of using a surfactant-free product is you get to specify the surfactant, and ensure use of an aquatic-labeled product. Vendors that sell aquatic-labeled herbicides will also carry aquatic-labeled surfactants.

Triclopyr Products

Choosing a triclopyr product is more complex than for glyphosate because there are several distinct formulations, summarized in Table 1. Until recently, the choice was simple, as the choice was using the water soluble, aquatic-labeled 3-pound gallon (e.g. "Garlon 3A") or the oil-soluble, terrestrial-only, 4-pound gallon (e.g. "Garlon 4 Ultra"). The oil-soluble formulation readily mixes in water, and has a more favorable Signal Word

(CAUTION compared to DANGER for "Garlon 3A"), but due to the lack of aquatic labeling and increased chance of volatilization in hot weather, the water-soluble form was the logical choice. The drawback is that applicators also making basal bark applications had two forms of triclopyr in inventory.

In recent years, two new aquatic-labeled formulations became available. The water-soluble, 4-pound gallon ("Vastlan") features the labeled uses of "Garlon 3A" and equivalents, a better Signal Word (WARNING compared to DANGER), a less volatile formulation, and a more concentrated product. The second new product ("Trycera") is formulated as the parent-acid, or "free acid", rather than as water-soluble amine or ammonium salt ("Garlon 3A", "Vastlan") or oil-soluble ester ("Garlon 4 Ultra"). The acid-formulation has a DANGER Signal Word, mixes in water or oil, has aquatic labeling, and can be used for basal bark as well as foliar and cut stem treatments. Acid formulations are described as low-odor, but first-hand experience suggests "different-odor".

| Product Example | Form | lb/gal | Signal Word | Aquatic Label | Basal Bark |
|-----------------|-----------------------------|--------|-------------|---------------|------------|
| Garlon 3A | water soluble | 3.0 | DANGER | Yes | No |
| Vastlan | water soluble | 4.0 | WARNING | Yes | No |
| Garlon 4 Ultra | oil soluble, water miscible | 4.0 | CAUTION | No | Yes |
| Trycera | oil soluble, water miscible | 2.87 | DANGER | Yes | Yes |

Cautions

There are a few caveats to mixing glyphosate and triclopyr. At high concentrations there is incompatibility and precipitate will form in the spray mixture. Two approaches mitigate this effect. This first is limit spray carrier volume to no less than 15 gallons per acre and avoid storing unused mix when practical. The second procedure is to follow the mixing instructions from the "Garlon 3A" label, which specifies adding triclopyr first in the mixing process, to a tank filled to at least 75 percent of the final mix volume (rather than the common practice of starting with 50 percent of the final mix volume), and mixing completely before and during adding the

glyphosate product. This ensures the two herbicides are not together in the mix at high concentrations prior to reaching final dilution. Following these steps will prevent incompatibilities.

There are consequences to this limited compatibility of glyphosate and triclopyr herbicides. Using ultra-low volume (10 gallons carrier volume per acre or less) application methods is not an option. This operational constraint reinforces the label restrictions against applying triclopyr products using a mistblower.



Additional Herbicides

Glyphosate plus triclopyr is a very potent mix, and strikes a very useful balance between activity and reduced risk. It is a great fit for situations where less-experienced applicators are the primary users and have the

opportunity to revisit treatment areas and make touch-up applications. The activity of the mix can be increased, though definitely at the cost of increased risk to non-targets, or loss of aquatic-labeling, or both. Examples of likely tank-mix partners include metsulfuron-methyl and imazapyr. Although glyphosate plus triclopyr is very effective, adding another herbicide to the mix can be thought to increase the margin of error when treating individual targets. A commercial applicator will treat hundreds of stems in a day. It is easy to have brief lapses in concentration. Having a more potent mix that results in fewer misses reduces retreatment time. The scarcest component in land stewardship is personnel time. Less retreatment is more work directed elsewhere.

Adding metsulfuron-methyl (e.g. "Escort XP") will definitely boost activity against certain species, particularly multiflora rose and tree-of-heaven, but will leave active residue that will inhibit seed germination and require a delay for replanting. Metsulfuron-methyl is only labeled for terrestrial use, so use near open water would need to be more cautious.

The addition of imazapyr (e.g. "Polaris") can retain the aquatic-labeled nature of the mix, based on product selection, but definitely increases risk of damage to non-target plants. Imazapyr has considerable soil activity against certain hardwood species, and is notorious for its activity on oaks. There is a narrow "sweet spot" between extra activity and non-target damage. Select imazapyr products with care, as they are available in both 2-pound and 4-pound gallons (with nearly identical product names), and aquatic and terrestrial-only labels. If you're not careful, you could be applying a half- or double-rate. Do not use imazapyr if replanting hardwoods is part of the management of the treatment area.

Summary

A mixture of glyphosate plus triclopyr is a useful standard mix for managing most vegetation targets. It has broad activity, and low risk to non-targets, and is economical both in terms of per-acre cost and container size, for the commercial applicator or the individual landowner.

