UNIVERSITY OF CALIFORNIA
Agriculture and Natural Resources
Forest Stewardship

Post-Fire: Managing Competing Vegetation with Herbicide

Extensive, high-severity wildfires in California's conifer forests have impeded natural forest regeneration, leaving the future of these forests at risk (Welch et al. 2016). Post-fire reforestation efforts extend far beyond seed collection and planting. Though often overlooked, site-preparation and post-planting removal of competing vegetation are essential to ensure the survival of vulnerable conifer seedlings. The primary reason to control the growth of shrubs and grasses is to increase the survival and development of planted tree seedlings (and to reduce fuels). Resprouting species, as well as invasives, often dominate and thrive in disturbed landscapes. Without control, competition for soil moisture, can reduce growth or outright kill planted conifers, as well as native herbaceous species (Plamboeck et al. 2009). See *Post-Fire Managing Competing Vegetation to Improve Reforestation Outcomes*.

Herbicides are well known as an effective and relatively inexpensive method to control vegetation. Research, including a 20-yearlong study from the US Forest Service's Pacific Southwest Research Station, has documented herbicide's ability to promote the growth of larger trees in post-fire landscapes (Zhang et al. 2022; McDonald and Fidler 2010).

Native plant species also benefit from the removal of dominating post-fire shrub species, like *Ceanothus* species and *Arctostaphylos* (manzanita) species. Herbicide use can increase native plant species richness in reforested areas (DiTomaso et al. 1997; Bohlman et al. 2016) which promotes future forest health, wildlife habitat and ecosystem resilience.

As with other tools used in post-fire management, including mastication, grazing, and prescribed fire, there are tradeoffs in selectivity, timing, and cost. Often, multiple treatment approaches are required to effectively meet management objectives.

Image 1: Comparison of treatments after the 2021 Caldor Fire. On the left no herbicide was used and lots of Ceanothus *resprouted. On the right, post-emergent herbicide was used to reduce shrubs before planting. Photo: Nic Dutch, 2024.*

Image 2: A combination of pre-emergent and post-emergent herbicide treatments in Plumas County. Photo: Nic Dutch, 2025.

Concerns over the potential environmental impact of herbicides, specifically glyphosate, have prompted further investigation that addresses its use in forestry (Busse et al. 2001, Tatum 2004).

Herbicides: Pre- and Post-Emergent

Pre-emergent: These herbicides are applied extensively to the soil during site preparation to prevent the germination or emergence of plant species that would compete with the tree seedlings to be planted. Since pre-emergent herbicides are applied before seedlings are planted, conifer tolerance of a selected herbicide is not a concern. A common pre-emergent herbicide in forest management is hexazinone, known for its efficacy to control the growth of woody shrubs.

Post-emergent: These herbicides kill plants on direct contact with foliage and are applied after the target plant species has already emerged from the soil. These are often applied in post-fire environments, where naturally growing and planted seedlings may be intermixed with surviving and resprouting competing species. Resprouting vegetation is not controlled with pre-emergent herbicides, therefore targeting of oaks and shrubs like greenleaf manzanita, tanoak, and chinquapin, requires use of a post-emergent herbicide.

For both types, pre- and post-emergent, the timing of herbicide application is critical. As more time passes, the target competing species becomes more established therefore harder and more expensive to control.

Mode of Action, Selectivity, and Timing

Other differences between herbicides are based on their mode of action, selectivity, timing, and application method. Herbicides work through various metabolic mechanisms, or modes of action, to disrupt plant growth. Common modes of actions for herbicides used within forestry are prohibiting photosynthesis, preventing plant growth and causing uncontrolled and excessive growth (*See table below*).

Selectivity: Selectivity refers to the ability of an herbicide to effectively control the desired target species while minimizing impacts to desired plants. The components of an herbicide can influence its selectivity, including the active ingredient, formulation, and application rate. Selectivity can also be influenced by the timing and location of the application. Identifying the desired selectivity of an herbicide is a critical component of a vegetation management plan and determines the herbicide recommended by a licensed professional.

Timing: Timing of herbicide application influences its efficacy. Treatments should be applied during specific growth stages to effectively kill targeted species and to avoid detrimental impacts on the desired species. Applications during the dormant season, or at certain growth stages may help prevent impacts to desired species.

Application: Application methods vary from broadcast or direct foliar spraying, stem injectors, and others depending on desired selectivity. Applying the product directly to undesirable vegetation can safeguard the seedlings you are trying to protect.

Herbicide Use for Reforestation

The type and method of herbicide used will favor the growth and survival of some species over others. Use of pre-emergent herbicides before post-fire tree planting has many advantages. Pre-emergents act before invasive and shrub germination, reducing the effort needed to control them after seedlings are planted. Since pre-emergents are used before planting, potential injury to seedlings is prevented compared to what could occur with spraying after they are planted.

Post-emergent herbicides can also be used selectively with directed applications to the target plants' foliage. To avoid impact on growing conifers, foliar application should ideally occur between late summer and fall after the seedlings' buds have hardened.

Herbicide selection is dependent on target vegetation species, as well as local environmental considerations in given areas. An integrated approach that combines both pre- and post-emergent herbicides and a mix of herbicides is often needed to control multiple species of plants and ensure continued growth of tree seedlings and thus successful reforestation.

Regulations, Safety, and Compliance

The use of herbicides is subject to regulatory oversight to ensure their safe and responsible application. The California Department of Pesticide Regulation (DPR) regulates the licensing, sale, and use of pesticides under state laws, which are often more restrictive than regulations of the federal government and most other states. California regulations require that a licensed pest control advisor (PCA) provides a written recommendation based upon strict adherence to product guidelines and restrictions, and in consideration of local ecology. Only certified PCAs and DPR certified applicators may apply herbicides, wearing personal protective equipment. Regulations and permitting may vary by county, so be sure to

contact your local County Agricultural Commissioner for regulatory information, as well as technical assistance. For an informed conversation with a PCA, read the table below and look up herbicides via the Herbicide Resistance Action Committee.

Common Herbicides for Conifer Reforestation *(Adapted from Reforestation Practices for Conifers in California)c*

Active Ingredient	Most Common Trade Name	Mode of Action	Application	Considerations – timing, location, reforestation	Directed Use	Relative Toxicity (LD-50 mg/kg)*
2,4-D ester	Weedone LV-6	Causes uncontrolled and excessive growth	Foliar	Spring/Fall	Site prep/ directed release	1380
Aminopyralid	Milestone	Causes uncontrolled and excessive growth	Foliar/Soil	Spring/Fall	Site prep/ directed release	>5000
Atrazine	Atrazine 4L	Prevents photosynthesis	Soil	Pre-emergent/requires rainfall to activate	Site prep/ release	>2000
Clopyralid	Transline	Causes uncontrolled and excessive growth	Foliar/ Soil	Spring/Fall	Site prep/ release	>5000
Fluroxypyr	Vista XRT	Causes uncontrolled and excessive growth	Foliar	Spring/Fall	Site prep/ direct release	>5000
Glyphosate	Accord XRT II	Prevents plant growth	Foliar	Fall prior to planting or as post-emergent	Site prep/ release	>5000
Hexazinone	Velpar DF	Prevents photosynthesis	Soil	Pre-emergent/requires rainfall to activate	Site prep/ release	1310
Imazapyr	Polaris AC	Stops root and shoot growth	Foliar/ Soil	Pre-emergent/ requires rainfall to activate	Site prep	>5000
Sulfometuron-methyl	Oust XP	Stops root and shoot growth	Soil	Used for coastal species primarily	Site prep/ release	>5000
Triclopyr ester	Forestry Garlon XRT	Causes uncontrolled and excessive growth	Foliar	Spring/Fall	Site prep/direct release	2966

*Relative Toxicity LD-50 is the lethal concentration required to kill 50% of sample group and is one way to measure toxicity. It's expressed in milligrams of substance per kilogram of body weight. A lower number indicates higher toxicity. For comparison the LD-50 of caffeine is 346 mg/kg and vitamin D is 42 mg/kg.

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Prepared by: Nic Dutch, Thomas Getts, Ricky Satomi, Camila Quintana Del Carpio
Reviewed by: UC Cooperative Extension Post-Fire Forest Resilience Stewardship Team *Release Date: March/2026*