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Research Brief for Resource Managers

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Fire and invasives: *Ailanthus altissima*

Rebbeck J, Hutchinson T, Iverson LR (2019) ***Effects of prescribed fire and stem-injection herbicide on Ailanthus altissima demographics and survival.*** *Forest Ecology and Management 2019, 122-131.*

Click here for the original journal article.

What comes to mind when you think of plants and trees from different ecosystems that have invaded your local forest? Do you suspect that your old favorite trees will never return? Or that new seedlings of native plants have no chance of breaking through the mass of invasives? Non-native invasive species (NNIS) have become ecosystem disruptors, crowding out native regeneration and out-competing slower growth forms, causing managers to seek out new ways to slow and stop the disruption.

Many fire and land managers have wondered if prescribed fire would help reduce non-native invasive species. Joanne Rebbeck, Todd Hutchinson, and Louis Iverson, scientists from the USDA Forest Service's Northern Research Station, asked that same question in southeastern Ohio in an oak-dominated forest. *Ailanthus altissima* (tree of heaven, or stink tree) is a species with origins in China and Taiwan that can now be found on every continent except Antarctica. It has rapidly expanded in Ohio's Tar Hollow State Forest, and these researchers were interested in how a typical dormant season prescribed fire or fire combined with herbicidal stem injection would change the balance of species in the forest.

Photo by Jan Samanek, Phytosanitary Administration, Bugwood.org

Management Implications

- Non-native invasive species have different life history traits that can help or hinder the use of prescribed fire for control.
- *Ailanthus altissima* produces an initial flush of germinating seeds after a burn, but most of those germinants do not survive after four years.
- Factors such as light levels, mineral soil, other non-native and native species present, fire intensity, and herbicide use all contribute to whether *Ailanthus* survives post-burn.

Ailanthus has numerous traits that could possibly give it an advantage against other species after a disturbance. This species is not shade-tolerant; therefore a fire that increases light levels may benefit *Ailanthus*. It produces sprouts easily and can sometimes sprout up to 90 feet from a parent tree. It is also a prolific seed producer. Wind-blown seeds from a parent tree can be found up to 330 feet away. Additionally, its seeds can survive up to five years in soil; therefore, seeds can be ready and waiting to take advantage of periodic openings in the forest canopy. This species typically produces

leaves later in the spring than many natives, with higher air temperatures required for bud break.

The researchers monitored seedlings, saplings and trees of different sizes for *Ailanthus* in ten, 10m radius plots for burned only (B), herbicide only (H), burned plus herbicide (B+H), and controls (no burn or herbicide). Measurements were taken to assess burn severity, light levels, and percent of die-back versus re-sprouting. Results showed that in the burned-only plots, 62.9% were top-killed but re-sprouted (i.e., no *Ailanthus* trees were completely killed by the burn). However, mortality was observed in the smaller size classes (<10cm diameter at breast height), with 29.5% killed and 67% top-killed with re-sprout. For herbicide-only plots, 72.4% of the trees were completely killed. The rest exhibited stunted growth and re-sprouts. **For the burn plus herbicide plots, results were amplified, with 98.8% of trees killed and 1.2% top-killed with re-sprout.** Additionally, in the B + H treatment 99.4% of saplings died.

The results above refer to existing *Ailanthus*, but do not show how *Ailanthus* seeds in the soil responded. Initially, there was a 2.7-fold increase in germinating seeds in H-only plots, a 4.7-fold increase in B plots, and a 5.7-times increase in B+H plots post-treatment (see Figure 1). However, significantly, these new plants did not survive and in 2014, four years later, germinants all decreased in abundance, while seedlings and saplings all decreased below or recovered to pre-treatment levels.

These results show that although an initial flush of *Ailanthus* seeds could germinate after a burn or other disturbance, those plants may not survive. The fact that survival decreased as time went on was attributed to the fact that light levels did not change dramatically; *Ailanthus* is shade-intolerant and was outcompeted by fast shade-tolerant re-sprouters including native and invasive *Rubus* spp. (blackberry, raspberry and wineberry) and *Smilax* spp. (greenbriar). Additionally, the authors concluded that since the burns occurred before full leaf-out, *Ailanthus* might have experienced more mortality if the burn had been later in the spring, when more of the trees' resources were dedicated to growth and leaf production.

Long-term studies to understand the best combination of factors to decrease non-native invasive species survival and increase native species survival are needed to refine these types of results. Factors such as fire intensity, seasonality, other invasive species, and forest structure need to be closely monitored to understand the impact of prescribed fire on *Ailanthus altissima* and other invasive plants.

Figure 1. *(adapted from Figure 4 in Rebbeck et al 2019) Ailanthus altissima* germinating seeds (per hectare) pre-treatment (2009) and post-treatment (2010) until four years post-treatment (2014).