Invasive plants and chestnut restoration: Allelopathic effects of three invasive plant species on American chestnut seedlings

Hunter¹, B.A; McCarthy¹, B.C. 2014
¹Department of Environmental and Plant Biology, Ohio University, Athens, Ohio 45701

Introduction

Now that chestnut hybrids have been bred to have an increased level of resistance, and restoration of the species has increased levels of feasibility, scientists have begun to more carefully assess the potential impediments to reintroduction.

An important factor that may impact chestnut restoration are non-native invasive species (NNIS). Since the loss of American chestnut in these forests, there has been a proliferation of these species, many of which chestnut has never been in contact with historically.

Three non-native invasive species, common in Ohio, are tree of heaven (Ailanthus altissima), garlic mustard (Alliaria petiolata), and Amur honeysuckle (Lonicera maackii). All three of these species have one trait in common—they are all allelopathic. This means that even if these plants are removed from a site, there may be legacy impact with the soil.

Methods

For this study, B₃F₂ chestnut hybrids derived from the Clapper variety were planted both in the Ohio University greenhouse and at the West State Research Gardens in Athens, Ohio. The greenhouse chestnuts were treated weekly with aqueous biomass extracts from the three invasive species and red maple. The garden chestnuts were treated monthly with biomass from the invasive species and other chestnut trees. Heights of all chestnuts were measured after a few months.

Results

Heights were measured over time for chestnuts grown in the greenhouse and treated with aqueous biomass extracts. The treatments with the greatest difference in height were both high and low treatments of tree of heaven (Fig. 3).

![Figure 3. Average height of Castanea dentata hybrids treated with aqueous extracts of invasive plant biomass. Treatments were Ailanthus altissima (AIAL) high and low, Lonicera Maackii (LOMA) high and low, Alliaria petiolata (ALPE) high low, Acer rubrum (ACRU), and water (control). Plants were grown in the greenhouse at Ohio University. Error bars represent one standard error.](image)

However when it came to the final height measured, the high treatment of tree of heaven aqueous extracts was the only treatment that continued to have different heights (Fig. 6).

![Figure 6. Measurements of C. dentata grown in the Ohio University greenhouse. Plants had been treated with aqueous extracts allelopathic invasive biomass. Treatments were Ailanthus altissima (AIAL) high and low, Lonicera Maackii (LOMA) high and low, Alliaria petiolata (ALPE) high and low, Acer rubrum (ACRU) high, and water/control (C). Plants were grown in the greenhouse at Ohio University. Error bars represent one standard error.](image)

When biomass was added instead of aqueous extracts and when plants were grown outdoors instead of in the greenhouse, garlic mustard treatments were the only treatments that differed. When low levels of garlic mustard leaves were added, heights of the chestnuts were larger than other low leaf treatments and when roots garlic mustard were added the heights of chestnuts were lower than other root treatments (Fig. 7).

![Figure 7. Average change in height of Castanea dentata seedlings growing in soil with leaf (a.) or root (b.) biomass added. Treatments were control (C), leaf or root biomass from C. dentata (CADE), Ailanthus altissima (AIAL), Lonicera Maackii (LOMA), and Alliaria petiolata (ALPE). Error bars represent standard error.](image)

Conclusions

Greenhouse and field experiments provided differing results. In the greenhouse, tree of heaven had a noticeable negative effect on seedling growth. In the field experiment, garlic mustard (roots) had the most negative impact. There are likely reasons why the results differed based upon environment and soil biota.

More importantly, we clearly demonstrated that at least two species of NNIS can have a negative impact on chestnut restoration. Thus, this element needs to be considered at a local site level prior to any restoration effort.

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