Understanding natural pollen dispersal and the effect of controlled burns in American chestnut restoration

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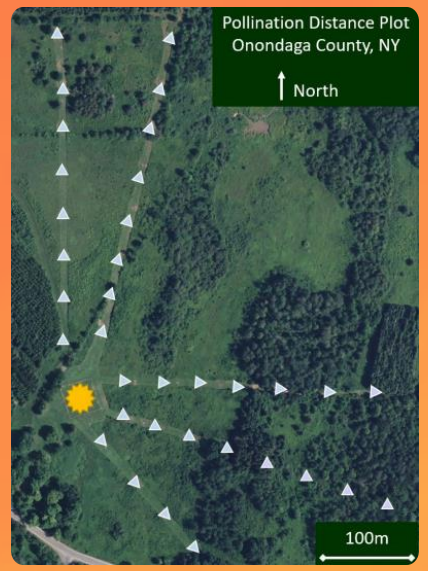
Introduction

The American chestnut was once one of the most important dominant hardwood trees in the eastern United States. Since the arrival of the deadly chestnut blight *Cryphonectria parasitica* in 1904, which rapidly spread over the eastern US in a matter of decades, the American chestnut has become functionally extinct. With the development and likely deregulation of the Darling 58 trees, a transgenic blight-resistant line of American chestnuts, it may soon become possible to begin restoration of these trees within their natural habitat.

Ecological research of mature *C. dentata* has been limited by their century-long absence. In order to maximize the success of American chestnut restoration, research is needed to elucidate the details of their ecological life histories. That is what my research aims to contribute to.

Effective Pollination Distance



It is not known what the effective pollination distance is of transgenic Darling 58 trees *in situ*, or of the American chestnut more generally. Understanding this will inform optimal planting distances for restorative American chestnut plantings. The objective of this portion of my research is to determine the natural successful pollination distance of American chestnut.

A research plot has been established to determine the effective pollination distance of C. dentata. This includes a central plot of transgenic trees that will be allowed to freely release pollen, and radial spokes of male-sterile trees to receive pollen. Successful pollination will be quantified in terms of the number of fertilized burs on each recipient tree after the summer pollination season.

I will also capture pollen to compare airborne viable pollen quantities to successful pollination events. This will allow me to create a rate of successful pollinations compared to pollen quantities.

My hypothesis is that the closer to the central plot a receptive tree is, the more fertilized burs it will have.

Seedling Fire Tolerance

American chestnuts may be tolerant of fire; historically, they commonly grew alongside oaks, which are tolerant of fire. They also have many traits consistently seen in fire-tolerant species, such as a vigorous resprouting capability. However, despite multiple anecdotal observations this has not been widely researched or established. If they are tolerant of fire, controlled burns could help their establishment by suppressing invasive undergrowth or competitive tree species like red maple. The objective of this portion of my research is to determine survival rates and response of American chestnut seedlings to controlled burns.

Controlled burn plots have been established, with 6 control plots, 6 plots that will be burned in spring, and 6 plots that will be burned in fall. Each burn plot per season will be burned with a different ignition technique resulting in a gradient of fire severities. Each plot will be planted with 36 wild-type American chestnut seedlings. The survival, growth rates, resprouting rates, and physiological changes of all the seedlings will be recorded in spring and fall before each burn. This will give continuous growth data for all the trees both with and without fire. Chestnuts have been planted in 2 control plots and 4 fall burn plots. We have taken measurements of the planted chestnuts, including root collar diameter, height, number of stems, and number of live leaves. The first fall burn has already occurred.

My hypothesis is that the burned seedlings will die back but most will resprout. I think the trees burned in the spring will resprout more vigorously.

Above: Diagram of the different ignition techniques.

Left: The 2023 fall burn. Right: Map of the burn sites. Border color denotes burn timing: green, control; yellow, spring; orange, fall.