UPDATE ON ONGOING EMERALD ASH BORER RESEARCH AT DOE FARM

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At the beginning of June, we initiated our research project (see Todd's presentation to the Land Stewardship Subcommittee here) on the invasive beetle known as the emerald ash borer at Doe Farm. Our project is part of a larger study across multiple field sites evaluating how as green and white ash get older (and bigger), they may differ in their ability to defend themselves against the beetle. We are also studying how tree age and size may influence how likely the emerald ash borer is to be parasitized by specialized parasitoid wasps that have been released as part of management programs against the beetle throughout the United States (learn more about emerald ash borer management in NH here: https://nhbugs.org/detection-control-and-protection-methods).

Shortly after we identified, flagged, and took GPS points of all of the trees we will be studying at Doe Farm, we began the first part of our project. This involves creating a dime-sized hole in our ash so that we can remove a portion of the phloem tissue that exists directly underneath the bark of trees. The phloem tissue is where the immature emerald ash borer spends most of its 1-2 years of feeding before chewing its way out of the tree as an adult beetle. Because the beetle feeds within the phloem of trees, we are most interested in the defensive chemicals that exist within this tissue.

How plants defend themselves against herbivores such as insects can be broken down into two categories. The first category is referred to as 'constitutive' defenses, which are those that are always present. A familiar example may be the thorns on a rosebush that serve to deter feeding at all times. There are also chemical defenses that are always present, although we may not be able to see and detect them as easily. By sampling the phloem tissue at the beginning of our study, we are able to determine the amounts and identities of defensive chemicals in ash prior to being attacked by an herbivore. If some trees have specific chemicals present, or large amounts of others, it may explain why those trees are able to resist the beetle more than others.

The second category of defenses in plants is referred to as "induced". These are physical or chemical changes that occur within a plant after it has been damaged by some event, such as an herbivore beginning to feed on it. To return to the example of thorns, some plants after damage may produce *more* thorns in response to ongoing, and to protect against future herbivory. Chemical defenses function in the same way, the amounts of some compounds may increase or decrease, as well as new compounds may be produced to protect the plant. A strong or rapid response by some trees may also explain their ability to resist the emerald ash borer.

One week after we completed the removal of phloem tissue from all of our study trees, we returned to Doe Farm to impose the first of our experimental treatments to the same trees. We have three treatments that allow us to study the responses of trees to the emerald ash borer. One of these treatments is a control. In the control treatment we do nothing but sample the chemistry of our trees at the beginning and end of our experiment. In our first experimental treatment, we artificially infest the trees with emerald ash borer by placing its eggs onto their bark. This treatment allows us to understand how feeding by the emerald ash borer causes changes in the defensive chemicals present in the phloem of our study trees. As part of this treatment, we protect the eggs that we have placed on trees from rain and predation with cotton, gauze, and Tyvek house wrap. We also place Tyvek house wrap on some of our other trees in the event that this may influence the production of defensive chemicals in our trees. In approximately two weeks, these eggs will hatch and the immature emerald ash borer will begin feeding. It is at this time we will

impose our second experimental treatment that simulates insect attack to the trees. Stay tuned for future updates where I will explain the purpose of this treatment.