Lingering (resilient) ash detection: a tool for ash conservation

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What are lingering ash?

Lingering ("resilient") ash are chemically untreated mature (≥4" dbh) trees that retain healthy crowns through peak EAB invasion. They are not trees that merely survive peak invasion nor are they trees that reach maturity after peak infestation ("ingrowth"). Lingering ash have been found for all three widespread Northeastern species: white (*Fraxinus americana*), green (*F. pennsylvanica*), and black/brown (*F. nigra*). Although lingering ash display some resistance, it often is not complete, meaning that even these trees will likely eventually decline. Thus, lingering ash must be found once ash mortality is high enough to reveal them, but not too long afterwards.

Lingering white ash (left) and black ash (right) found in Hudson Valley; photo by R. Wildova.

What roles can lingering ash play in ash conservation?

1. Providing scion for resistance breeding

The USFS EAB Resistance Breeding Project has shown that for green ash, scion (twigs) collected from lingering trees can be grafted to yield replicates that can be used for selective breeding, yielding highly resistant trees. Thus, one role for lingering ash is furnishing scion for resistance breeding.

EAB larva killed by lingering ash; photo by J. Koch.

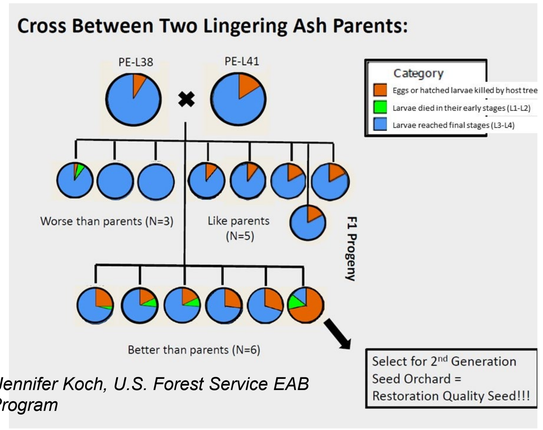

Chart provided by Dr. Jennifer Koch, U.S. Forest Service EAB Resistance Breeding Program

Scion collection from lingering tree (left), photo by J. Rosenthal; clone bank from lingering ash, Cornell Botanic Gardens 5 months after grafting (middle and right); photos by T. Bittner.

Selective breeding has not yet been performed using trees grafted from black ash. However, scion collected from multiple lingering black along with white and green ash by the Monitoring and Managing Ash (MaMA) program in New York have been used to create clone banks, which can be used for selective breeding. As areas long invaded by EAB spread across the Northeast, the number of lingering trees found should increase.

2. Furnishing seeds for resistance breeding

In contrast to untargeted seed collection (especially in areas that haven't reached high mortality), seed collection targeting lingering ash may take advantage of the natural selection that set them apart from the trees that succumbed to EAB (depending upon proximity of other lingering ash to furnish pollen). However, even the resistance of seedlings produced by targeted seed collection will likely be lower than those produced in a seed orchard of confirmed resistant parents. The table below shows how scion collection, targeted seed collection and untargeted seed collection compare with and can complement each other.

	LA scion collection	LA-targeted seed collection	Untargeted seed collection
Advantages	• Takes advantage of natural selection pressure revealing trees with some resistance. • Grafted trees have same level of partial resistance as LA that furnished scion • Grafted trees flower much sooner than trees from seed, enabling early selective crossing.	• May take advantage of natural selection pressure revealing trees with some resistance. • Half of seeds' genes from LA mother, so more likely (depending on whether father a LA) than untargeted seed to produce seedlings with some resistance, but less likely than seeds from two known LA parents. • Captures more genetic variation than scion. • Propagation from seed doesn't require grafting facility.	• Potentially captures greatest genetic variation. • Propagation from seed doesn't require grafting facility.
Disadvantages	• Can (presently) be identified for collection only after high mortality. • Technical expertise and equipment needed for scion collection and grafting.	• Can (presently) be identified for collection only after high mortality. • Because only ½ of seeds' genes from mother, won't reliably produce trees with same level of resistance. • Need seed repository suitable for intended purposes.	• Trees grown from untargeted seeds likely to be largely susceptible (rate varies between species). • Need seed repository suitable for intended purposes.

3. Improving population genetics in situ

To the extent that lingering ash's partial resistance is heritable, and depending upon lingering ash's relative abundance within pollinating distance, they might enable seed produced on-site that reflects selection for resilience.

Another important management tool – let's use it!

By taking advantage of the partial resistance found in many lingering ash, their detection can provide unique benefits. However, it is not a panacea; rather, its impacts can be greatest when combined with other tools. For example, increased resistance and reduced pest pressure (from e.g., biocontrol) can complement each other to reduce EAB's impacts.

How can managers facilitate lingering ash detection?

One way to enable detection is to monitor EAB-induced mortality (through plot establishment or Rapid Ash Mortality Assessments) to determine when it has gotten high enough to reveal lingering ash. Even more important, in addition to setting aside for mortality monitoring, we encourage leaving enough healthy trees untreated and uncut that there will be a reasonable likelihood of some ultimately manifesting as lingering ash. As the table below shows, lingering ash detection needs to be integrated into overall management strategies and includes important tasks even (especially) after almost all the ash have died.

Note: Even if high enough mortality not yet reached to identify lingering ash, if any mature untreated ash are especially healthy when most are dead/declining, these are potential lingering ash, i.e., the pool of trees from which lingering ash can emerge. If possible, refrain from cutting them unless they start to decline.

Tasks for each stage of EAB infestation

Pre-infestation EAB not yet present	**Early infestation** Some EAB signs; mix of healthy and declining trees	**Mid-infestation** Widespread EAB signs; some ash mortality; few healthy trees	**Late infestation** Ash largely dead, with remainder very unhealthy except for *rare* **lingering ash**
Assess ash presence/importance			
Document infestation onset			
Decide which trees to be treated vs. cut vs. left for mortality monitoring/lingering ash detection as part of overall management strategy			
Identify/implement other site-appropriate silvicultural and mitigation (for, e.g., invasive plants, hydrological changes) approaches			
	Identify sites for parasitoid release; conduct releases		
Establish/use **MaMA Mortality Monitoring Plots**; detect when thresholds reached			
		Do **Rapid Ash Mortality Assessments (RAMAs)** in areas with ash mortality; detect when thresholds reached	
		Record, report, protect **potential lingering ash**	
			Find/mark, protect **lingering ash**, report for possible **scion collection**, possibly collect their seed

What should you do if you find possible lingering ash?

- ❑ Report them through the MaMA Lingering Search project. We will work with you to enable taking any subsequent steps that you see fit, including possible scion collection.
- ❑ Protect them from cutting until after scion collected. Then, if it's necessary to cut lingering ash, there at least will already be genetic replicates for breeding.
- ❑ Do not treat them chemically until they've been reported and LA status verified; however, treating them afterwards is encouraged to prolong their in situ persistence.

*To find out more about the MaMA program, please visit **www.monitoringash.org** or email us at **outreach@monitoringash.org.***

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