



# Observations from X-ray Elemental Analysis of Ash Tree species related to the Growth of Emerald Ash Borer Populations



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## Abstract

In recent years, the Emerald Ash Borer (EAB) has been a proliferating invasive species and environmental issue for the Midwest. These beetles are indigenous to Russia and Eastern Asian countries and are thought to have been introduced to the Midwestern region of the United States in the 1990’s. Over this period, the EAB has widened its range, killing green, black and white ash trees. With no certain sustainable solution to controlling this species, our student’s Exemplary Research Program from Lemont High School for the 2015-16 school year observed a variety of bark samples from common ash species including European Ash, Biltmore Ash, and Chinese Ash. It was found that the non-resistant ash (Biltmore) contained three times more calcium in the phloem than the resistant Chinese Ash. Last year, the students continued to examine these three bark samples in order to test for anomalies and observed a thick bark Chinese Ash. It was found that the nonresistant European and Biltmore ash trees contained much larger amounts of calcium and potassium while the Chinese ash had an extreme amount of zinc. For the 2017-2018 school year, students collected ash tree bark for further analysis and leaf samples to test for further connections. This further research of the elemental differences could allow for future prevention of the EAB.

A better understanding of the EAB and their impact on ash species is important. If we can better understand EAB, perhaps we can attain an increased understanding of other invasive species. EAB are spreading almost completely unchecked in the Midwest. To this day, there is no certain solution to the control and spread of the beetles. Currently, the only counter to the spread of these beetles is through the use of expensive insecticides, and the culling of ash trees surrounding affected areas. Data collection will involve determining the specific elements and structures present in each sample. Then, the differences between each species will be compared along with the species’ resistance to the ash borer. Our group will use X-ray fluorescence to investigate the tissue structures of the ash.

## Emerald Ash Borer

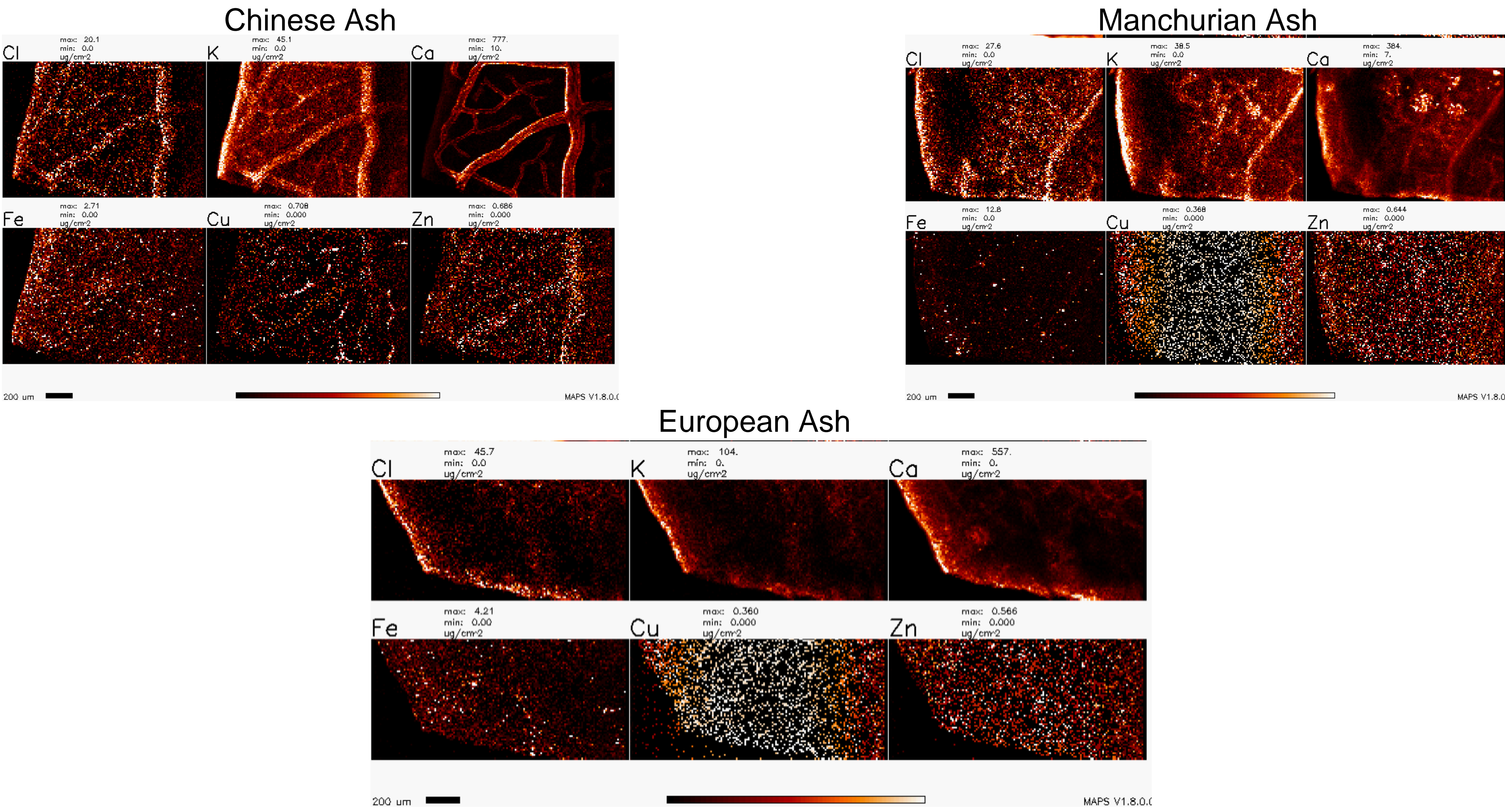


## Methods

Dr. Chuck Cannon from the Morton Arboretum provided four different leaf samples for the experiment. The Arboretum holds extensive records for each tree studied, and the samples were harvested on September 4, 2017.

- Sample 1 is Chinese Ash, which has some resistance to the EAB.
- Sample 2 is Manchurian Ash, which also has some resistance the EAB.
- Sample 3 is European Ash, which has no resistance to the EAB.

From 2015-2017, the bark of the samples were analyzed by the Advanced Photon Source (APS) to find the concentration of elements within the bark, Cambium, and Phloem. In 2018, we tested leaf samples of all the trees and focused on concentrations Zinc, Calcium and Copper. The experiment took place from Wednesday, March 6th to Thursday, March 7th and was conducted by APS scientist Dr. Olga Antipova at beamline 2-ID- E (microscale X-ray fluorescence beamline).



## Summary

Although further research needs to be conducted, we have evidence that would suggest that an abundance of Copper and Zinc in Ash tree leaves could be a defining factor of the resistance to the Ash Borer Beetle. This is because zinc is a critical part in a plants immune system and how well ash trees will fare against infestations and diseases. Copper is important as it has many vital roles in a plant biology and one of those is the formation of lignin. Lignin is an organic polymer that strengthens cell walls and is important in the formation of bark/wood. In the Chinese ash, there was a significant increase in the quantity of Zinc compared to the other samples tested. In the Manchurian, larger quantities of Copper were found. Due to both the resistant trees having close to or larger quantities of these elements in comparison to the European Ash, there might be a correlation between the presence of those element and a reason why some trees are more resistant to the Emerald Ash Borer than others.

These elemental differences may be caused by the way the samples were fixated, which can sometimes alter the concentrations of the elements in certain areas. However, if fixation did not alter the concentrations, they may be the reason why certain varieties of ash trees are more resistant to the EAB than others. The resistant and non-resistant samples both had noticeably different concentrations and distributions of the elements studied. With further research, the elemental differences may help create a way to prevent future EAB devastation.

## Summary of Findings

Element	Chinese Ash (2018) Resistant	Manchurian Ash (2018) Resistant	European Ash (2018) Non-resistant
Zinc	1.2x the amount of zinc	2x the amount of zinc	1x amount of Zinc
Copper	1.6x the amount	.9x the amount	1x amount of Copper
Calcium	1.1x the amount	1x amount	1x the amount