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Mycorrhizal drivers of non-native pest richness in U.S. Forests

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Overview: We know that pests (insects and pathogens) cause significant damage to forests and that mycorrhizal fungi play a role in nutrient cycling, nutrient availability, and plant health. However, we do not yet know how mycorrhizal associations with trees affect pest invasions. The purpose of this study is to clarify the relationships between mycorrhizal associations with trees and different types of pest invasions.

Background: The two main mycorrhizal fungi groups are ectomycorrhizae (EM) and arbuscular mycorrhizae (AM). EM fungi adhere to the outside of tree root cells and deliver organic N and amino acids to the tree. AM fungi grow into the cell wall of tree root cells and primarily deliver inorganic N to the tree. In this study, we are interested in how different pest guilds are related to these two types of mycorrhizal fungi. The guilds we investigate are borers (bore into tree tissues), defoliators (consume plant material, often leaves), sap feeders (suck the sap from plants), and pathogens (infect and colonize trees; diseases).

Hypothesis and Prediction:

- **Hypothesis:** Higher nutrient availability in plant tissues of AM-associated trees[1] leads to increased pest richness in forests dominated by AM-associated trees.
- **Prediction:** There are more AM-associated trees used as hosts by pathogens than EM-associated trees.

Methods:

- **Spatial analysis:** spatial model to test if EM- and AM-associated tree densities are significantly related to pest richness at the county level[3] across the U.S.
- **Non-spatial analysis:** group number of trees used as hosts by 1) pest guild, and 2) EM- or AM-associated, then use χ^2 tests to compare groups statistically.
- Future work will also include additional non-spatial analysis of native pests.

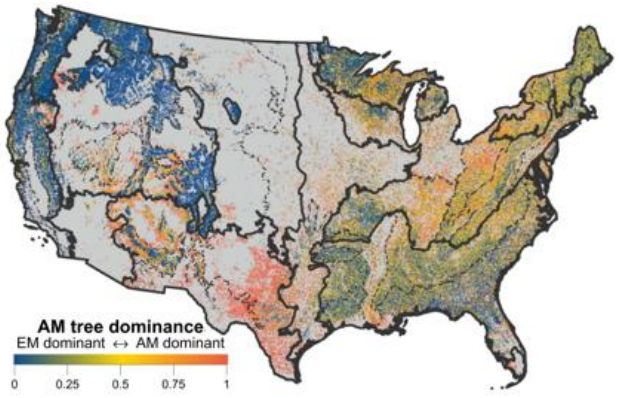

Figure 1. From Jo et al. 2019[2]. Tree dominance by mycorrhizal association in forests across the U.S.

Eastern U.S.

	AM Basal Area	EM Basal Area
All Pest	+	**+**
Borers	+	+
Defoliators	+	+
Pathogens	+	+
Sap-Feeders	-	+

Western U.S.

	AM Basal Area	EM Basal Area
All Pest	+	+
Borers	-	
Defoliators	+	-
Pathogens	+	**+**
Sap-Feeders	+	+

*Note: bolded text indicates resulting estimate is associated with a P-value < 0.05
*Note: blank space indicates variable was removed from model during backwards elimination

Figure 2. Preliminary results of the spatial analysis, indicating that areas with higher densities of EM trees had more pest species in the eastern U.S., and had more pathogen species in the western U.S.

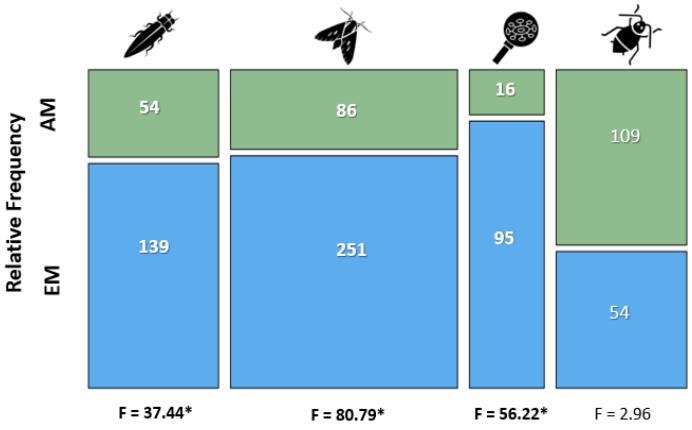

Figure 3. Preliminary results of the non-spatial analysis, showing that EM-associated trees had more pests per tree species for all guilds except-sap feeders.

FOR FURTHER READING:

[1]Averill et al. 2019. DOI: https://doi.org/10.1073/pnas.1906655116

[2]Jo et al. 2019. DOI: 10.1126/sciadv.aav6358.

[3]Liebhold et al 2013. DOI: 10.1111/ddi.12112.