

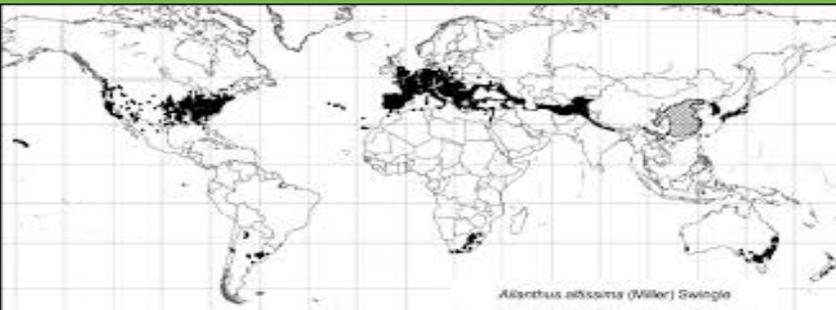
# Summer drought reduces the growth of invasive tree-of-heaven seedlings

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## Introduction

*Ailanthus altissima* is an invasive species that is plaguing the eastern portion of the United States after being introduced in the mid-1750's. Over the past 260 years, *A. altissima* has spread slowly through the rest of the country. Albright et al. (2010) showed that tree-of-heaven was much less likely to occur in the United States west of 100° W, especially when California excluded. In Utah County, Utah, it seems the species only grows in urban areas with supplemental water. Our study was designed to see the effects of drought conditions on seedling growth during the summer months.



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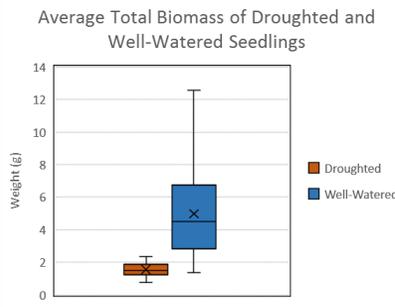
## Methods

1. Collection of *A. altissima* seeds.
2. Random selection of seeds and measurement.
3. Preparation and planting of seedlings.
4. Creating drought conditions and measurement.
5. Weighing stems and roots.

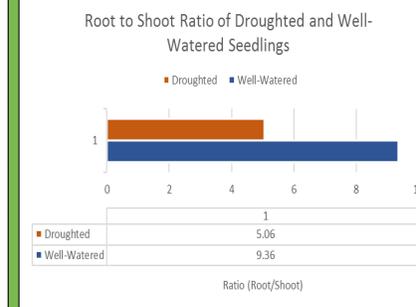


## Results

Our drought treatment significantly reduced the change in final height and mass of the tree-of-heaven seedlings in our study. For droughted seedlings, change in height from May 27- October 15 was 27.3% less than that of well-watered seedlings ( $p = 0.002$ ), while final height was 19.8% lower ( $p = 0.002$ , Fig. 1), and final total biomass was 68.6 % lower ( $p < 0.001$ , Fig. 2). Genetic differences were marginally significant for change in height ( $p = 0.074$ ), but no other growth parameters differed significantly among the half-sibling families. Final stem mass was 46.4% lower ( $p < 0.001$ ) and final root mass was 71.2% lower ( $p < 0.001$ ). Further, root-to-shoot ratios differed in the two treatments. The mean root-to-shoot ratio for well-watered seedlings was 9.36, while the ratio for droughted seedlings was 5.06 (45.9% lower for droughted seedlings,  $p < 0.001$ , Fig. 3).



**Figure 2.** This graph shows the comparison of the average total biomass of droughted and well-watered seedlings.



**Figure 3.** This graph shows the disparity between the root-to-shoot ratios of droughted and well-watered seedlings.

## References

- Albright, T. P., Chen, H., Chen, L., & Guo, Q. (2010). The ecological niche and reciprocal prediction of the disjunct distribution of an invasive species: the example of *Ailanthus altissima*. *Biological Invasions*, 12(8), 2413-2427.
- Moore, J. E., & Lacey, E. P. (2009). A comparison of germination and early growth of four early successional tree species of the southeastern United States in different soil and water regimes. *The American Midland Naturalist*, 162(2), 388-394.
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**Figure 1.** This graph shows the average height of the seedlings in the two treatments throughout the 20-week experiment.

## Discussion

The effects of drought conditions on the tree-of-heaven seedlings were negative and statistically significant across a variety of metrics and may help explain why tree-of-heaven is much more common in the eastern United States than in the western United States (Albright et al. 2010). Our findings contradict Moore and Lacey (2009) who did not find a significant effect of their drought treatment on the growth of tree-of-heaven. This could be due to the intensity of the drought treatment used. Their low water treatment plants received 230 mL of water per week, whereas ours received 60mL of water per week in the spring and 120 mL of water per week in the summer. Similar to the results of Moore and Lacey (2009), however, we found that tree-of-heaven seedlings put a proportionately large amount of their resources to root production in their first season of growth (Pan and Bassuk 1986), and thus had high root-to-shoot ratios. A relatively large allocation to roots could help tree-of-heaven seedlings survive drought conditions, although our well-watered seedlings had higher root-to-shoot ratios than did our droughted seedlings.