Propagation methods and restoration potential of Eastern hemlock, an endangered Minnesota conifer.

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INTRODUCTION

- Eastern hemlock is a common native conifer in the eastern US. Minnesota is the northwestern edge of its range and it is listed as an endangered species.
- There are fewer than 50 mature trees left in the wild near Duluth, MN.
- Additional cultivated trees of possible MN origin exist at the Minnesota Landscape Arboretum (MLA) in Chanhassen, MN, the Eloise Butler Wildflower Garden (EBWG) in Minneapolis, MN, and various State Parks.
- The MLA trees are of known wild provenance, grown from seed produced by an extirpated population near Mille Lacs Lake, MN.

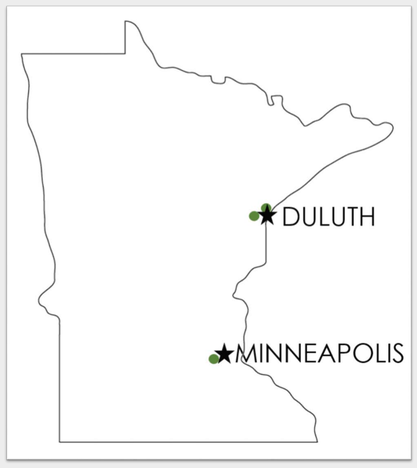

Fig. 1: Tree locations including cultivated trees at the MLA and two native populations near Duluth.

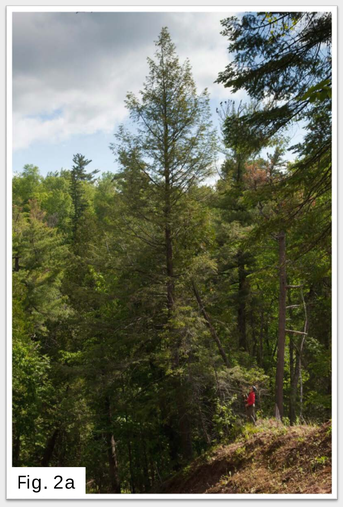
Fig. 2a


Fig. 2b

Fig. 2a and b: Examples of a native tree (Fig. 2a, Hemlock Ravine Scientific and Natural Area, photo credit: David Hansen) and a cultivated tree (Fig. 2b, Minnesota Landscape Arboretum).

OBJECTIVES

1. Optimize seed and vegetative propagation methods for use in management.
2. Determine if genotypic specificity among MLA and wild trees can inform nursery practices and help develop *ex situ* and *in situ* conservation and restoration plans.

MATERIALS AND METHODS

Seed Propagation

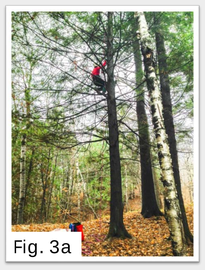
Fig. 3a


Fig. 3b

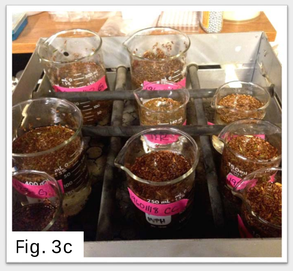
Fig. 3c


Fig. 3d

Collected seed from two trees in two native populations (Fig. 3a; MS1and HR4) and four cultivated trees in the MLA (Fig. 3b; 19570423-B, 19570423-G,19601118-CC, 19601118-O).

Imbibed seeds in water (Fig. 3c) and cold-moist stratified 12 weeks prior to sowing.

Sowed by broadcasting and hand-misted. Temperature kept between 53° F and 90° F. Assessed germination after 8 weeks (Fig. 3d).

Vegetative Propagation: Winter Cuttings


Fig. 4a

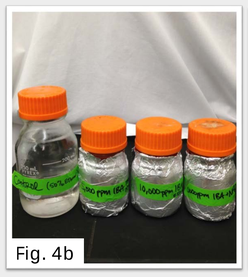
Fig. 4b

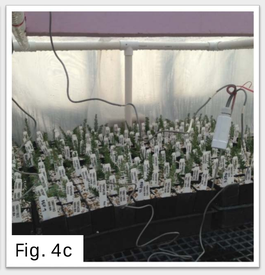
Fig. 4c


Fig. 4d

Collected cuttings in January 2015 (Fig. 4a) from 4 wild provenance trees and 2 nursery source trees at the MLA.

Dipped each cutting in 1 of 4 auxin treatments (Fig. 4b; Control—50% ethanol solution, 5000 ppm IBA, 10000 ppm IBA, 5000 ppm IBA + NAA) and stuck in a 2:1 perlite/vermiculite media (Fig. 4c).

Placed cuttings in a humidity tent (Fig. 4d) in a propagation house. Temperature kept between 60° F and 100° F. Measured rooting after 6 months. Analyzed using ANOVA and pairwise comparisons.

ACKNOWLEDGEMENTS:

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Scan me!

PRELIMINARY RESULTS

Vegetative Propagation

Table 1

	Accession Effect	Treatment Effect	Pairwise Comparisons
Cuttings mortality	**p<.001**	**p=.003**	10000 ppm IBA showed significantly less mortality than 5000 ppm IBA+NAA (p=.001)
Callus growth	**p<.001**	**p=.029**	10000 ppm IBA and 5000 ppm IBA showed significantly more callus growth than the control (p=.050)
Number of roots	**p<.001**	p=.067	19601118-CC had more roots than all other accessions (p=.0001 to p=.0003) and 10000 ppm IBA was the only treatment that differed from the control (p=.083)
Length of longest root	**p<.001**	p=.203	19601118-CC had longer roots than all other accessions (p=.0001 to p=.0064)


Fig. 5a


Fig. 5b

Fig. 5a and b: A majority of cuttings had callus formation (Fig. 5a; 68.75%) but only a small percentage rooted (Fig. 5b; 3.8%).

Table 1: Effects of Accession and Treatment on response variables.

Wild provenance accession 19601118-CC yielded the highest percentage of rooted cuttings and longest roots.

10000 ppm IBA was the most successful auxin concentration.

Seed Propagation

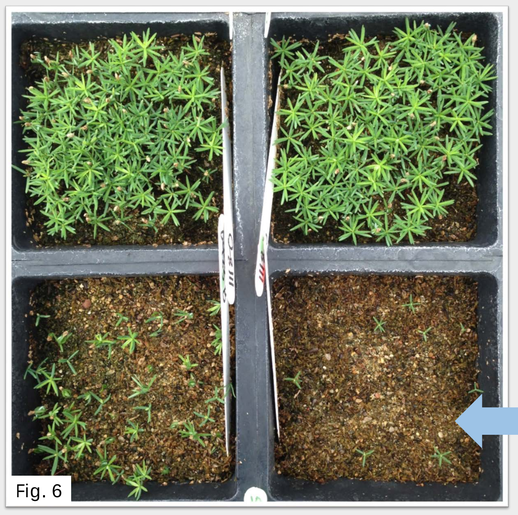
Fig. 6

Table 2: Estimated germination rates for two native trees (HR4 and MS1) and four MLA cultivated trees. Germination rates were higher in cultivated trees.

Fig. 6: Germination from left to right, back to front: 19601118-O, 19601118-O, 19570423-B, MS1. Of these accessions, MS1 was the only wild collected seed and had the lowest germination rate.

Table 2

Accession	Estimated Germination Rate
HR4	2%
MS1	3%
19570423-B	14%
19570423-G	30%
19601118-CC	11%
19601118-O	28%

Fig. 7a and b: Wild-derived seedlings (Fig. 7b) tend to be smaller than seedlings from cultivated sources (Fig. 7a).

Fig. 7a

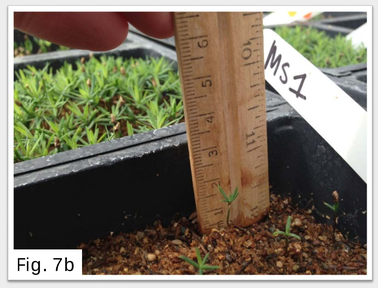

Fig. 7b

DISCUSSION AND IMPLICATIONS

- There was little overall rooting and widespread mortality. There is genotypic specificity for vegetative propagation with preference for the wild provenance accession 19601118-CC, although additional summer and winter cuttings studies are needed to confirm this pattern.
- Differences in germination rates between genotypes could be due to a variety of factors including differences in seed handling, genetic disposition and collection date. Cones from MLA trees were collected two weeks earlier than cones from wild trees.
- It is important to determine which mature trees produce viable seed and vegetative propagation material in order to effectively focus our efforts.
- Through continuing studies and collaborations with the MLA and the MN Department of Natural Resources, we have the potential to propagate existing trees to preserve genetic diversity and integrity by introducing Minnesota-sourced seed into restorations and conservation horticulture.


Fig. 8

Fig. 8: An Eastern hemlock downed by the 2012 floods at Hemlock Ravine SNA, where at least 2 mature hemlocks were lost. Damage like this highlights the need for conservation action.