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Increasing the number of herbaceous species appropriate for restoration of nutrient capture by forest remnants in agricultural landscapes

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Abstract
The researchers investigated methods for restoration of six forest herbaceous perennial species with potential for increasing nutrient capture and storage in degraded remnant forest systems in Iowa. They conducted common garden (greenhouse) and field planting experiments using local and non-local propagules.

Disciplines
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Co-investigators:
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Budget:
$4,000 for year one

Q How successful are transplanted individuals of these species in terms of survival? Are there differences in vegetative and reproductive growth among source populations of these plants that could influence their long-term performance?

ECOLOGY

A Generally, bare-root plants from local (97 percent) and non-local (100 percent) populations had very high survival rates in the common garden study. For the field study, average survival rates were 83 percent (with one exception as noted) for local seedlings and 81 percent for non-local plants.

Background

A number of forest perennial herbaceous species that are relatively abundant in preserved forests are known to play an important role in seasonal nutrient capture in these systems. However, these species are lacking in many remnant forest systems that have been altered by human use (e.g., grazed and urban forests). In spite of their importance for nutrient capture, relatively few protocols are available to forest land owners and managers to support successful establishment of these plants and few local sources of transplant stock are available.

Objectives for this project were to:

1. evaluate transplant success of a number of herbaceous woodland perennials when planted in degraded forest remnants where they are rare or absent; and
2. compare performance of transplants from local versus non-local source populations.

Approach and methods

The researchers excavated local (central Iowa) and non-local (Yellow River State Forest) bare-root seedlings of six species (wild ginger, Virginia waterleaf, Virginia bluebell, jumpseed, hispid buttercup, and zig-zag goldenrod) in April, 2014. Fifteen individual plants of each species from each source population were planted and grown in the ISU-Natural Resource Ecology and Management (NREM) forestry greenhouse from April to November 2014. For the field study, four plants of each species from each source population were planted in each of five plots located at three urban forest sites in Ames (a total of 60 plants per species for each source population). Plants at field sites were monitored during the 2014 and 2015 growing seasons. For both greenhouse (2014 only) and field (2014 and 2015) transplants, the team measured vegetative (stem diameter, plant height, leaf number, and/or leaf area) and reproductive (flower number, fruit number, seed number, and/or seed weight) characteristics at the time of peak production for each species.

Emily Altrichter digging up Hydrophyllum virginianum *to transplant to restoration sites.*

Results and discussion

The investigating team found that average second-year survival rates for bare-root seedlings were comparable for local (83 percent for five of the six species) and non-local (81 percent overall for all species) plants. Based on the common garden experiment, they noted morphological evidence of genetic differences between local and non-local plant populations for about half of the traits that were measured. Based on performance in the field planting, however, it was determined that there was a high degree of variation in expression of those genetic differences, suggesting that phenotypic plasticity could influence the success of non-local propagules in restoration projects.

Conclusions

Based on two-year field results indicating overall survival rates near 80 percent, five of the species that were tested appear to be suitable for restoration using bare-root seedlings. The exception, local plants for zig-zag goldenrod (only 40 percent survival), may have been affected by late-season flooding. In the common garden study, genetic differences were expressed morphologically for about one-half of the traits that we examined. For some traits, these differences were not apparent for at least one year when measured in the field, suggesting plasticity in response to environmental conditions. Long-term monitoring of field plots will be necessary to continue to assess the responses of these species to local environmental conditions.

Project investigators suggest that restorationists could use both local (if available) and non-local plant sources, and recommend careful monitoring of plants by source population to document performance and inform ongoing/future forest understory restoration efforts.

Impact of results

Biomass production and tissue nutrient content analyses are currently being completed for transplanted stock (local and non-local) excavated at their respective points of peak growth in the second growing season after planting. The researchers also are completing a related study of biomass production and nutrient capture by intact 0.25-m2 plots of beakgrass, jumpseed, zig-zag goldenrod, and James' sedge excavated from preserved forests during 2014 and 2015. This data will extend their previous work on early-growing herbaceous perennials and allow comparisons between those species and additional species potentially suitable for restoration that exhibit peak growth later in the growing season.

Education and outreach

Thompson J., C. McMullen, E. Altricther, and C. Griffin. 2014. Herbaceous perennial species for woodland restoration – An update. Annual Meeting of the Iowa Nursery and Landscape Association Research Corporation. Ames, IA.

Altrichter, E., Mabry, C., Thompson, J., and Grossi, A. 2015. Woodland herbaceous layer restoration in urban forests: Assessing key species. Society for Ecological

Forest herbaceous perennials were grown in the ISU Forestry greenhouse to test for genetic differences between local and non-local populations.

Restoration World Conference, Manchester, U.K. (abstract and poster presentation).
Altrichter, E., J. Thompson, C. McMullen, and A. Grossi. 2015. Identifying and assessing key species for forest herbaceous layer restoration. Society of American Foresters Annual Convention, Baton Rouge, LA (abstract and poster presentation).

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