Does provenance matter? Assessing ecotypal variation to promote restoration success

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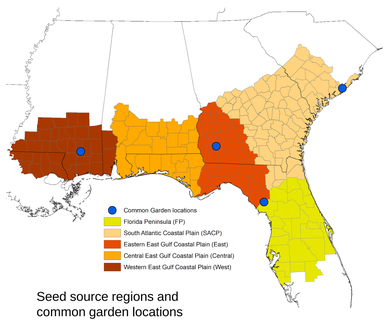
Introduction

- Restoration of native ground cover is a top conservation priority in the longleaf pine ecosystem of the southeastern United States (SE).
- Lack of commercially available local seed sources is a limiting factor.
- Many species associated with longleaf pine grow throughout the SE and Midwest (MW), and seed is often sourced from MW populations.
- Ecotypes may vary greatly across the range of a species, depending on the degree of adaptation to local environmental conditions.
- The distance an ecotype can be moved and still be ecologically appropriate for restoration is unknown and likely varies by species.
- More information is needed to delineate seed transfer zones that are most likely to lead to successful restoration outcomes across the SE.

Methods

Seed collection

- 6 species that occur throughout the longleaf pine – wiregrass (*Pinus palustris – Aristida stricta*) ecosystem were identified as desirable candidates for ground cover restoration.
- Seed from 3 populations of 5 geographic source regions was collected in Fall 2012.
- Commercially available seed from MW seed sources was obtained for a subset of species.



Seed source regions and common garden locations

Germination phenology

- Germination phenology was examined by sowing 100 seeds in each of 3 replicates for each population in a shadehouse environment.
- Germinated seeds were counted and discarded daily for one month, weekly for one year, and biweekly thereafter.
- Differences in phenology (days until 50 percent of seed germination had occurred) were compared among geographic source regions.

Common garden experiment

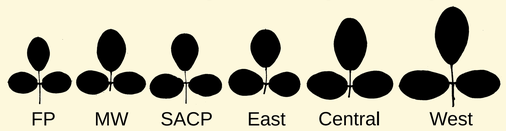
- 30 seedlings of each population were planted in 4 irrigated common gardens throughout the SE in Fall 2013.
- Mortality and flowering are censused monthly.
- Leaf area was calculated from scanned images of leaf samples of all individuals.
- Other metrics include maximum height and biomass at the end of the growing season.
- Differences in growth and survival for each species will be analyzed with a two-way ANOVA with source region and common garden site as factors.

Common garden site in GA

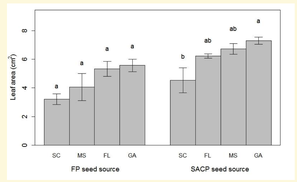
Preliminary Results

Lespedeza hirta (hairy lespedeza)

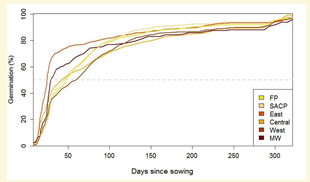
Leaf area: Significant source × site interaction
Germination phenology: Highly variable within source region, so that differences among regions are not significant
Flowering phenology: Up to 35% of individuals from MW have bloomed; no other source regions have begun flowering



L. hirta leaf samples representing mean leaf area for each seed source



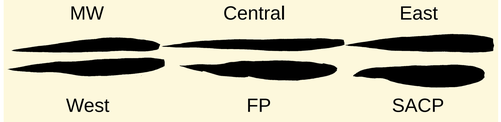
Mean leaf area (+/- SE) of *L. hirta* for two source regions at all garden sites



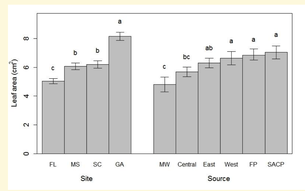
L. hirta germination phenology

Solidago odora (anise-scented goldenrod)

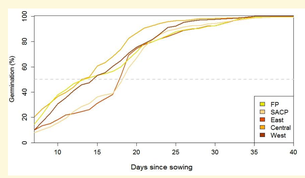
Leaf area: Significant effect of site and source
Germination phenology: No difference among source regions
Flowering phenology: Up to 40% of individuals of some source regions have bloomed in FL, while few have flowered in GA and SC, and none in MS.



S. odora leaf samples representing mean leaf area for each seed source



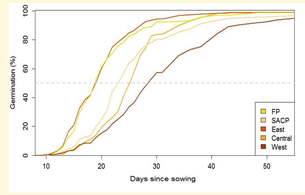
Mean leaf area (+/- SE) of *Sol. odora* by garden site and seed source



Sol. odora germination phenology

Aristida stricta (wiregrass)

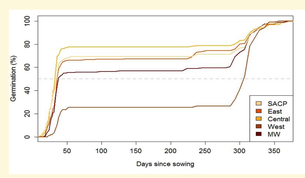
Germination phenology: Significant effect of source region
Flowering phenology: A few individuals of most regions have flowered in FL and SC; no flowering has begun in GA and MS



A. stricta germination phenology

Sorghastrum nutans (Indiangrass)

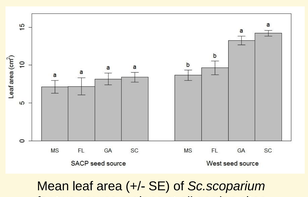
Leaf area: No effect of source or site
Germination phenology: Significant effect of source region
Flowering phenology: Up to 10% of individuals from MW have bloomed, no other source regions have begun flowering



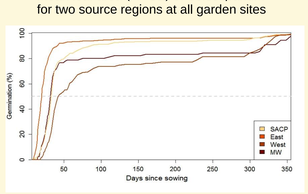
Sor. nutans germination phenology

Schizachyrium scoparium (little bluestem)

Leaf area: Significant source × site interaction
Germination phenology: Significant effect of source region
Flowering phenology: Up to 18% of individuals from 2 regions have bloomed in GA; no other sites have had flowering individuals



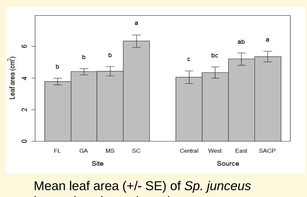
Mean leaf area (+/- SE) of *Sc.scoparium* for two source regions at all garden sites



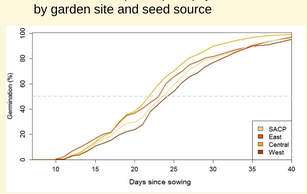
Sc. scoparium germination phenology

Sporobolus junceus (piney woods dropseed)

Leaf area: Significant effect of site and source
Germination phenology: No difference among source regions
Flowering phenology: A few individuals of most source regions have flowered in FL and GA; no flowering has begun in MS and SC



Mean leaf area (+/- SE) of *Sp. junceus* by garden site and seed source



Sp. junceus germination phenology

Conclusions

- Preliminary findings of characteristics measured suggest that responses are species specific.
- Leaf morphology of many species appears to be influenced by adaptations to source region as well as growing site conditions.
- Species traits lack congruency in adaptation to source regions.
- Flowering of MW seed sources appears to begin earlier at most garden sites compared to SE seed sources.

Future directions

- Data collection at common garden sites will continue through the end of 2015.
- Investigation of many more species will be required to determine if patterns of ecotypic differentiation emerge.
- Analysis of genetic variation within and among regions would provide additional information about ecotypal differences.
- Field trials done in a restoration context and monitored over time will be necessary to determine long-term viability of seed transfer zones.

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