Restoring Native Species to Control *Ruellia simplex* (Mexican Petunia) Invasions: New Data from Germination, Competition, and Revegetation Studies

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Outline

• Overview: *Ruellia simplex*

• [Germination] Germination of Selected Native Species: Efforts to Guide Revegetation Efforts in a Former Mexican Petunia-Invaded Floodplain

• [Competition] Suppression of the Invasive Ornamental *Ruellia simplex* (Mexican Petunia) by Native Species in a Greenhouse Study

• [Revegetation] Active Revegetation Efforts Using Native Species do not Initially Promote Invader Control in the Short Term in a *Ruellia simplex* (Mexican Petunia) Invaded Floodplain Forest in Florida, USA

• Conclusions
Overview: *Ruellia simplex* (Mexican Petunia)

- *Ruellia simplex* introduced for ornamental use from Mexico

- Listed as a FLEPPC Category II Invasive in 1999, promoted to a Category I Invasive in 2001

- UF/IFAS Assessment does not recommend its use in Florida (updated 2013)
**Known Control and Management Approaches**

- Characteristic distribution along floodplains (Hupp 2007)
  - Results show that seeds and shoot fragments disperse through streams (Seitz 2015)

- Glyphosate reduced *Ruellia* by 60-70% when sprayed once in either the fall or spring (Reinhardt Adams et al. 2014)
Need for Revegetation and Control

- Little native species recolonization after sprayed with glyphosate

- Active revegetation is needed
Germination
Germination of Selected Native Species: Efforts to Guide Revegetation Efforts in a Former Mexican Petunia-Invaded Floodplain

Submitted to Ecological Restoration
Introduction

• Objective: to determine germination behavior of natives and *Ruellia* to inform seeding approaches that promote native establishment

• Hypotheses:
  1. *Ruellia* seed will germinate readily and reach 50% of the final germination percent quickly
  2. Native species seed will germinate slower and under a narrower range of temperatures
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Andropogon glomeratus
Juncus effusus
Panicum longifolium
Solidago fistulosa
Materials and Methods

- Native seed obtained

- *Ruellia* seed collected from Lake Jesup (Sanford, FL)

- Treatments
  - 20/10 °C (winter)
  - 25/15 °C (fall)
  - 30/20 °C (spring)
  - 35/25 °C (summer)

- Germination data collected every other day for 28 days

- Final germination percentage (FGP) and T50 (days to 50% FGP) were determined per germination box
Results

A) A. glomeratus

B) J. effusus

C) P. longifolium

D) S. fistulosa

E) R. simplex

No difference
Discussion

• Hypothesis #1 supported: *Ruellia* FGP was high under all temperatures, reached T50 in 5-8 days, supports Wilson et al. (2004)

• Hypothesis #2 supported: Overall, native species had low FGP (no more than 30% was reached) and reached T50 at different times

• Previous observations note low *Ruellia* dominance in the field

❖ **Recommendation:** sow native seed at higher rates during the fall
Competition

Suppression of the Invasive Ornamental Ruellia simplex (Mexican Petunia) by Native Species in a Greenhouse Study

Introduction

• Objective: to identify native species compositions, native species seeding densities, and water level conditions that favored establishment of natives over *Ruellia*

• Hypotheses:
  1. High native seeding density would suppress *Ruellia* more than a lower seeding density
  2. *Ruellia* would be most competitive under saturated soil conditions compared to drier soil conditions
  3. A mix of multiple native species would suppress *Ruellia* to a greater degree than only a single native species (can diversity provide invasion resistance?)
Materials and Methods

• Treatments
  – Hydrology (saturated, unsaturated)
  – Native seed density (low=25 seeds/m² and high=50 seeds/m²)
  – Native composition: *Ruellia* alone, *Juncus* + *Ruellia*, *Solidago* + *Ruellia*, and native species mix + *Ruellia*)
Materials and Methods

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seedling establishment & total number of individuals (weekly)

shoot height (biweekly)

aboveground and belowground biomass (week 24)
Results: Solidago and native mix suppressed total biomass

Solidago and native species mix suppressed *Ruellia*
Discussion

• Hypothesis #1 could not be tested: low native germination prevented comparison between seeding densities

• Hypothesis #2 supported: confirmed Ruellia’s preference for saturated soils (Hupp 2007)

• Hypothesis #3 supported: Native species mix suppressed Ruellia total biomass, but Solidago did too
  – Ruellia had rapid establishment, so did Andropogon and Solidago
  – No suppression of Ruellia shoot height

❖ Recommendation: sow Solidago and/or a native species mix (that includes Andropogon and Solidago) at higher rates
Revegetation

Active Revegetation Efforts Using Native Species do not Promote Invader Control in the Short Term in a *Ruellia simplex* (Mexican petunia) Invaded Floodplain Forest in Florida, USA

Submitted to Applied Vegetation Science
Introduction

• Objective: to determine which revegetation approach would be most effective in *Ruellia* suppression and native plant establishment

• Hypotheses:
  1. Natural recolonization is not sufficient to restore the native plant community
  2. Seeding with a native species mix will limit *Ruellia* and restore the native plant community more effectively than seeding with two native species
  3. Planting seedlings will suppress *Ruellia* and restore the native plant community more effectively than seeding treatments
Materials and Methods

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Lake Jesup Conservation Area (Sanford, FL)
Materials and Methods

• Revegetation treatments:
  1. No pretreatment herbicide application and no revegetation (control)
  2. Pretreatment herbicide application and no revegetation (natural recolonization)
  3. Pretreatment herbicide application and seeding a two native species mix (*Juncus*, *Solidago*)
  4. Pretreatment herbicide application and seeding with a native species mix (*Andropogon*, *Juncus*, *Panicum*, *Solidago*)
  5. Pretreatment herbicide application and revegetation with plugs from a native species mix (*Andropogon*, *Juncus*, *Panicum*, *Solidago*)
Materials and Methods

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Stem density (every month), percent cover (every 3 months)

Biomass (1 year after revegetation)
Results: Herbicide application produced only treatment effect on *Ruellia* suppression.
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Revegetation did not effect *Ruellia* aboveground biomass.
Discussion

• Hypothesis #1 supported: natural recolonization was not sufficient

• Hypothesis #2 could not be tested: native species did not germinate in seeding treatments

• Hypothesis #3 could not be tested: no germination from seeding treatments prevented the comparison between propagule type

• Native species recovery may be a multi-year process with several revegetation efforts with additional chemical control
Conclusions

• Future research:
  1. Understand connection between elevated soil nutrients from stormwater runoff and *Ruellia* propagule pressure

  2. Several seeding/planting intervals over multiple years

  3. Incorporation of a growth regulator herbicide that targets rhizome growth

After glyphosate application, 97% of recolonizing *Ruellia* came from rhizomes (not seeds)
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