Cogongrass Invasion of the Southeastern Forests

*Impacts on Resource Availability, Species Diversity and Productivity*

Shibu Jose
H.E. Garrett Endowed Professor
School of Natural Resources and
Director
The Center for Agroforestry
University of Missouri
**Imperata cylindrica**: What is it?

- C₄ Perennial grass; native to SE Asia
- Tropical/subtropical
- Reproduces both sexually and asexually (rhizomes)
- Over 500 million ha worldwide
- 600,000 ha in the US
- Listed as a Federal noxious weed in the U.S.
- 7th worst weed in the world
A Good Intention Gone Bad!!

- 1912 - Accidentally introduced in Alabama from Japan
- 1920 - Intentionally brought to the US as a potential forage crop TX, MS, AL, FL
- Cattle ranchers, State DOT, SCS
How Can It be so Aggressive?

- **Fire / Disturbance Feedbacks**
  - Empty Niche Hypothesis / Elton’s hypothesis
  - Propagule Pressure hypothesis
  - Invasion Meltdown Hypothesis

- **Competition and Altered Nutrient Cycling**
  - Superior Competitor Hypothesis / Evolution of Increased Competitive Ability Hypothesis

- **Allelopathy**
  - Novel weapons Hypothesis
Disturb Cogongrass; It Comes Back with A Vengeance!

(Holzmueller and Jose, Biological Invasions; 2011)
Following Hurricane Ivan – Rapid Expansion

Biomass Removal following Hurricane Ivan (2004)

Overlay of Cogongrass Invasion with Biomass Removal

$y = 0.0025x + 0.0129$

$R^2 = 0.3574$
Roads and Trails – Corridors of Expansion!

Cogongrass Distribution - % contribution explained by each variable

<table>
<thead>
<tr>
<th>Variable</th>
<th>Percent contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Euclidean Dist. From Roads</td>
<td>65.7</td>
</tr>
<tr>
<td>Euclidean Dist. From Horse Trails</td>
<td>23.8</td>
</tr>
<tr>
<td>Euclidean Dist. From Trails</td>
<td>5.0</td>
</tr>
<tr>
<td>Euclidean Distance from pipeline</td>
<td>4.4</td>
</tr>
</tbody>
</table>

Tripathi and Jose, unpublished
What Happens When It Gets In?
What Happens When It Gets In?

>40 plant species /m²
(Walker and Peet, 1983)
Longleaf pine – Cogongrass Savanna?

Reduction in Species Diversity

Loss of Key Species from Sensitive Ecosystems
Cogongrass Can Accelerate Fire-induced Mortality!

![Graph showing the percentage mortality of Cogongrass and Sandhill in different height classes.](image)

Lippincot, 1997
Cogongrass Burns Hotter!

Lippincot, 1997
Decrease in Plantation Productivity

Daneshgar and Jose, 2008
Competition for Space - Above and Below

>60-70% total biomass

Up to 40 Mg/ha
Competing for Other Resources?

Light Response Curve - Cogongrass

Loblolly Pine $A_{\text{max}}$

Jose et al., 2002; Ramsey et al., 2003

Daneshgar and Jose, 2008
Competition for Water and Nutrients?

Daneshgar and Jose, 2008
Cogongrass Can Change N Dynamics in the Soil!

(Daneshgar and Jose, 2009)
Well, Cogongrass Can Change Many Soil Chemical Properties!

*I. Cylindrica* is known to produce Phenolic compounds such as Caffeic, ferulic, p-hydroxybenzoic, p-coumaric, vanillic, chlorogenic and syringic acids as allelopathic agents (Hussain and Abidi, 1991; Inderjit and Dakshini 1991; Hagan and Jose, 2013)

(Collins and Jose, 2010)
Cogongrass May Also Be Allelopathic!

<table>
<thead>
<tr>
<th>Common name</th>
<th>Scientific name</th>
<th>Family</th>
<th>Symbiont</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wiregrass</td>
<td><em>Aristida stricta</em></td>
<td>Poaceae</td>
<td>AM</td>
</tr>
<tr>
<td>Pinewood bluestem</td>
<td><em>Andropogon arctatus</em></td>
<td>Poaceae</td>
<td>AM</td>
</tr>
<tr>
<td>Rusty lyonia</td>
<td><em>Lyonia ferruginea</em></td>
<td>Ericaceae</td>
<td>EM</td>
</tr>
<tr>
<td>Slash pine</td>
<td><em>Pinus elliottii</em></td>
<td>Pinaceae</td>
<td>ECM</td>
</tr>
</tbody>
</table>
Watered with Either Cogongrass or Native Polyculture Leachate

1. Approximately 1.3 liters of DI H₂O added to each pot
2. Collection and filtration of approx. 1 L of “leachate”
3. 15 mL of fresh filtered leachate added to each tube 2X weekly*

*3 Cogongrass and 3 native pots were rotated so that leachate was collected from each at approximately 10 day intervals
Hagan and Jose, unpublished
Implications for Mycorrhizal Association in Wiregrass and Pines

Hagan and Jose, unpublished
# Chemical Profiling of the Leachates

<table>
<thead>
<tr>
<th>Compound</th>
<th>Concentration (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cogongrass</td>
</tr>
<tr>
<td>Gallic acid</td>
<td>3.03</td>
</tr>
<tr>
<td>Caffeic acid</td>
<td>0.85</td>
</tr>
<tr>
<td>Salicylic acid</td>
<td>0.61</td>
</tr>
<tr>
<td>Sinapinic acid</td>
<td>0.33</td>
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<tr>
<td>Benzoic acid</td>
<td>0.16</td>
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<tr>
<td>Emodin</td>
<td>0.16</td>
</tr>
<tr>
<td>Cinnamic acid</td>
<td>0.12</td>
</tr>
<tr>
<td>Ferulic acid</td>
<td>0.11</td>
</tr>
<tr>
<td>4-hydroxyphenylacetic acid</td>
<td>0.00</td>
</tr>
<tr>
<td>Cholorogenic acid</td>
<td>0.00</td>
</tr>
<tr>
<td>Resorcinol</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Hagan, Jose and Lin, 2013
A Novel Alkaloid?

Speculated structure: hexadecahydro-1-azachrysen-8-yl ester

Hagan, Jose and Lin, 2013
In Conclusion....

- We’ve just scratched the surface....
- Exploring the mechanisms by which cogongrass gains dominance may help us formulate early detection and rapid response strategies in vulnerable communities
- Much needs to be done to document its ecological and economic impacts which will help make policy decisions
Thank you!

Questions? Comments?