Evaluating the cold tolerance of wildtype and hybrid cogongrass (*Imperata cylindrica*)

Candice Prince, Greg MacDonald, Rima Lucardi

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**Imperata cylindrica** (Cogongrass)

- Native to southeast Asia

- Multiple introductions to southeastern US
  - Unintentional (packing material)
  - Intentional (forage)

- Pastures, roadsides, forests

- Displaces native species, alters fire regimes
Cogongrass Spread
Cogongrass Spread

Chris Evans, Bugwood.org
Cogongrass varieties

• Hubbard et al. (1944) and Santiago (1980):
  • *I. cylindrica* var. *europa* → North Africa, Mediterranean, Afghanistan
  • *I. cylindrica* var. *major* → Asia, Australia, Pacific Islands, east Africa
  • *I. cylindrica* var. *africana* → west Africa
  • *I. cylindrica* var. *latifolia* → northern India
  • *I. cylindrica* var. *condensata* → South America

• Ornamental: var. *rubra*, var. *koenigii*
Distribution in the U.S.
Ornamental Cogongrass (var. *koenigii* or var. *rubra*)

- Japanese Blood Grass, Red Baron
- Popular ornamental plant
- Northern distribution, more cold tolerant
- Marketed as sterile and non-invasive, banned for sale in many southeastern states, BUT.....
Japanese Blood Grass Plants - Imperata Red Baron - Gallon Pot
by Hirt's Gardens
$14.99 + $9.59 shipping

9GreenBox - Japanese Blood Grass - 4" Pot
by 9GreenBox
$7.99 + $5.99 shipping

Positive
On Sep 29, 2003, TerriFlorida from Plant City, FL wrote:
Japanese Blood Grass is easy, plant in average well drained soil in sun to light shade, and enjoy. It flowers foxtail plumes above the leaves in September in central Florida, nice tan over maroon effect. I will cut it back to about 6" in another month or so, to enjoy fresh foliage all winter here.
Ornamental Cogongrass (var. *koenigii* or var. *rubra*)

- Has been observed to revert under common garden greenhouse conditions (Cseke and Talley 2012)

- Has been observed producing flowers in Florida (May-June) (Thetford et al. 2009)
- Green foliage
- Constrained to southeast
- Not cold-tolerant
- Aggressive

+ Red foliage
- Pacific Northwest, Northeast, Midwest
- Cold-tolerant
- Marketed as non-aggressive

= ?
Hybrid Development

- Ornamental pollen grains (shipped frozen) → Maryland
- Wildtype → Hawthorne, FL
- Pollen grains introduced individually to wildtype flowers
- Seeds collected and germinated
- Genetic analysis confirmed hybridization (Lucardi et al. 2014)
Objectives and Hypotheses

• To evaluate the cold tolerance of wildtype and hybrid cogongrass

• Hypothesis: the hybrid would have greater cold tolerance than the wildtype
Cold Acclimation

• 150 rhizome segments (3 nodes) per variety in 4-inch pots
  • Commercial potting soil
  • Slow release fertilizer

• Cold acclimated in growth chambers:
  • 7 weeks: 32/26 °C, 14-hour photoperiod
  • 1 week: 24/14 °C, 14-hour photoperiod
  • 3 weeks: 18/5 °C, 10-hour photoperiod
Cold Acclimation

• Plant height, aboveground biomass recorded (62 plants per variety)

• Total nonstructural carbohydrates (TNC) measured in rhizomes (10 plants per variety)
  • TNC = total soluble sugars + starch

• Analyzed using one-way ANOVA, means separated using Tukey’s HSD
Cold Treatments

• Plants placed in freezer for 3 hours: 5, 0, -5, or -10 °C

• After 4 weeks: emergence from rhizomes, height, stem number, and aboveground and belowground biomass

• Analysis:
  • Emergence data: binomial logistic regression
  • All other data: linear regression

• Experiment repeated, data pooled between runs
## Prior to Cold Treatments

<table>
<thead>
<tr>
<th>Trait</th>
<th>Wildtype</th>
<th>Hybrid</th>
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</thead>
<tbody>
<tr>
<td>Height (cm)</td>
<td>42.83 ± 1.27 (a)</td>
<td>45.14 ± 1.26 (a)</td>
</tr>
<tr>
<td>Aboveground Biomass (g)</td>
<td>0.72 ± 0.04 (b)</td>
<td>1.16 ± 0.08 (a)</td>
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<tr>
<td>TNC (mg g⁻¹ dry weight)</td>
<td>99.57 ± 3.52 (b)</td>
<td>238.33 ± 8.67 (a)</td>
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</tbody>
</table>
y = 4.33 - 2.96(Variety) + 0.35(Temperature)
McFadden’s Pseudo-R² = 0.43
Aboveground Biomass (g)

\[ y = 0.58 - 0.39(\text{Variety}) + 0.04(\text{Temperature}) - 0.03(\text{Variety})(\text{Temperature}) \]

\[ R^2 = 0.28 \]
Belowground Biomass (g)

\[ y = 0.73 - 0.52(\text{Variety}) + 0.03(\text{Temperature}) - 0.02(\text{Variety})(\text{Temperature}) \]

\[ R^2 = 0.36 \]
Invasive Wildtype

Hybrid
Rhizomes of plants that did not emerge (-10 °C):

Hybrid:  
Wildtype:
$y = 40.73 - 18.07(\text{Variety}) + 1.59(\text{Temperature})$

$R^2 = 0.27.$

$y = 4.76 - 2.23(\text{Variety}) + 0.24(\text{Temperature})$

$R^2 = 0.36$
Conclusions

• Hybrid cogongrass $\rightarrow$ more cold tolerant than invasive wildtype

• Greater TNC concentrations in the rhizomes
  • Total soluble sugars + starch
  • TNC increases with cold acclimation in other perennial grass species
    (Patton et al. 2007)

• Greater emergence and growth across temperature treatments
Conclusions

• Hybrid had greater biomass even under control conditions (5 °C)
  • More aggressive?
  • Heterosis (hybrid vigor)
  • Potential management challenges

• More research needed to understand differences between hybrid and wildtype cogongrass
  • Growth
  • Competitive ability
  • Response to management
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cprince14@ufl.edu