Rhododendron Improvement at the David G. Leach Research Station

Steve Krebs

Atlantic Rhododendron & Horticulture Society
Halifax
October 2014
The Evening Menu

Rhododendrons at Holden Arboretum

Why hybridize?

A Leach retrospective

Next gen rhododendrons

Q & A
David G. Leach

cold hardy hybrids

USDA zone 5b -26 C/-15 F
Displays

2000 Leach Rhododendron selections

500 companion plants

Mountain Laurel
Magnolia
Hollies
Viburnum
Conifers
Redbud
public engagement
Helen S. Layer Rhododendron Garden

Shammarello Hybrids

Flame Azaleas
Eliot and Linda Paine
Rhododendron Discovery Garden

Creating a Hybrid Cultivar: Step by Step

1. Seed to Flower (4 years)
   - Cross varieties with potential traits
   - Grow and observe
2. Field Evaluation & Selection (8 years)
   - Expand one plant in the elements
   - Test the hybrid for performance
3. Proven Assessment
   - Additional analysis for reliability
   - Readymade hybrid
4. Commercial Propagation
   - Establish a business
   - Develop a market
   - Grow for specific locations

Species - Hybrids - Culture
Namesake Plants

R. ‘Holden’

R. ‘Maud Corning’
Species: the building blocks of hybrids

Subgenus *Hymenanthes*

~140 species

broad diversity

color

foliage

bloom date

stature

outlier ssp. adaptations
Flower Diversity
Asian Rhododendrons

thank you internet!
Rhododendron Leaf Diversity
Native Cold Hardy Rhododendrons

- R. catawbiense
- R. maximum
Leach Breeding: Foundation Plants

30% of collection

*R. ‘Fabia’*

50% of collection

*R. ‘Catalgla’*

*R. ‘Russel Harmon’*
Best of Leach: White

*R. ‘Mist Maiden’*  
*R. ‘Summer Snow’*
Best of Leach:  Pinks

*R. ‘Bravo!’*

*R. ‘Bali’*
Best of Leach: Reds

*R. ‘Red Sea’*

*R. ‘Singapore’*
Best of Leach: Yellows

*R. ‘Capistrano’*

*R. ‘Holden’s Solar Flair’*
Best of Leach: Big Leafed

R. ‘Spellbinder’

R. ‘Holden’s Spring Herald’
Assessment of Leach Hybrids

- **Positives**
  USDA zone 5 hardy
  Saturated flower colors

- **Negatives**
  Poor leaf retention/quality
  Limited adaptability
Breeding Rhododendrons for the 21st Century A.D.
Market Share of Rhododendrons

Niche market
e.g. ARS
diversity
novelty
regional

National Sales
Presence
the ‘ironclads’
reliable
adaptable
The Importance of Off-Site Trialing

“If you are not killing plants, you are not really stretching yourself as a gardener”

J C Raulston
Lower Baldwin Test Site:

zone 5
full exposure
pH 6.5
heavier soils

Many of the selections that do well in Madison, OH fail at Baldwin
Good Performers at Baldwin

77-24 #97-1 = [N. Belle x (atros. x wardii)] x Sahara
Good Performers at Baldwin

00-43 #07-3 = Ingrid Mehlquist x Rio
Good Performers at Baldwin

*R. ‘Ingrid Mehlquist’ x R. ‘Pride’s Early Red’*
Adding Landscape Value to Leach Hybrids

✓ Ornamental
✓ Cold Hardy (zone 5)

+ Root Rot Disease Resistance
+ Heat Tolerance (zone 8)

= Better consumer experience
= Broader market

functionally related?
Root Rot Disease Caused by *Phytophthora cinnamomomi*

- Leaf chlorosis/wilting
- Root and crown necrosis
Methods For Controlling *Phytophthora* Root Rot

**Existing controls**
- cultural
- chemical
- biological

**Additional controls**
- host resistance
- rootstock
Breeding with Resistant Species

*R. hyperythrum*

- Bud hardy zone 6
- Heat tolerant zone 8
- Dense, glossy foliage
- Floriferous
R. hyperythrum heat tolerance

Dr. John Thornton
Franklinton, LA

R. ‘Peppermint Twist’

R. ‘Radiance’™
Southgate™
High Breeding Value of \textit{R. hyperythrum}

\begin{align*}
\text{0\% (S)} & \quad \times \quad \text{100\% (R)} & \quad \rightarrow \quad \text{50\% (F}_1\text{)}
\end{align*}

percentage of \textit{R. hyperythrum} in seedlings

41 DAI
**F₁ Gains in Resistance (AUCs)**

*R. ‘Capistrano’ x R. hyperythrum*

\[
\text{Gain} = \frac{(S - F₁)}{(S - R)} \times 100 = 83\%
\]
Field Evaluation: First Generation Hybrids (2500+ seedlings in 2005)
F₁ Selections - Flowers
F₁ Selections – Dense, Mounded Habit
Environmental Stress Reduces Resistance

- host plant
- pathogen
- environment

predisposition
- salinity
- heat/cold
- drought
- flooding

disease
Flooding Stress Test
2011 Field Trial: 21 Genotypes

*R. hyperythrum* and its hybrids were less predisposed to root rot under flooding conditions.
## Results of Flooding Trial

<table>
<thead>
<tr>
<th>Test Group</th>
<th>N</th>
<th>Mean Root Rot Score non-flooded</th>
<th>Mean Root Rot Score flooded</th>
<th>t-test (P &lt; 0.05)</th>
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</thead>
<tbody>
<tr>
<td>Susceptible</td>
<td>8</td>
<td>4.9</td>
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Heat Stress Test Using Water Bath

Target Soil T’s

25 C / 77 F
30 C / 86 F
35 C / 95 F
40 C / 104 F
45 C / 113 F
50 C / 122 F

~ 1 hr to target, hold for 30 min
Results of Water Bath Heat Stress Test

R. ‘Ingrid Mehlquist’ loses resistance with $\uparrow T$

R. *hyperythrum* maintains resistance with $\uparrow T$
Southern Trials
165 F₁ selections

Plant Development Services Inc.
Southern Living Plant Collection™
Louisiana Trial  Dec 2013
Southern Trial (2 years)
Good Doers: ~30/165
Summary

• Hybrid rhododendrons with resistant roots
• Adaptable to hardiness zones 5 – 8
• Reduced pesticide use
• Potential to cope with climate change
Acknowledgements

Jing Wang
Hilary Wright
Susan Hanna

American Rhododendron Society
Stanley Smith Horticultural Trust
Norweb Fellowship
Southern Trials

• **Plant Introduction:**
  Identify which $F_1$ Ohio-selections grow well in southern climate

• **Hypothesis testing:**
  $F_1$ selections vary in level of resistance. Are the best southern performers also the most root rot resistance?
Controlled Inoculations and Screening

initiation on solid media

bulking up in liquid media
Field Evaluation: First Generation Hybrids (2500+ 4 year old seedlings)
Ornamental Results:

*R. hyperythrum* F₁s

R. 83-57 #90-2 x R. hyperythrum

R. ‘Henry’s Red’ x R. hyperythrum
Ornamental Results

*R. hyperythrum* F₁s

*R. ‘Samoa’ x R. hyperythrum*  
*R. ‘Singapore’ x R. hyperythrum*
Ornamental Results

*R. hyperythrum* $F_1$s
Ornamental Results: *R. hyperythrum* $F_1$s

*R. ‘Besse Howells’ x R. hyperythrum*
Proven Performers: purple

*R. ‘Catawbiense Boursault’*  
*R. ‘English Roseum’*
Proven Performers: white

R. ‘Chionoides’

R. ‘Mist Maiden’
Proven Performers: white

R. ‘Ingrid Mehlquist’

R. ‘Calsap’
Proven Performers: pink

*R. ‘Scintillation’*  
*R. ‘Brown Eyes’*
Proven Performers: pink

*R. ‘Summer Glow’*

*R. ‘Janet Blair’*
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Model for Predisposition (salinity)

- Increased ABA levels
- Inhibition of defense signaling pathways
- Stress treatment
- Pathogen challenge
**P. cinnamommi** Causal Organism

- broad host range – global impact
- primitive ‘fungus’
- motile zoospores
- spores persistent in field

zoospores  chlamydomospores
Confirmation of *P. cinnamomi*

- growth on selective media
- consistent colony morphology
- 96-100% sequence match to LPV3 storage protein in *P. cinnamomi*

* primers per Kong et al. (2003)
  Pl. Path. 52:681-