Hop Breeding:
Let’s Get It On

GREAT LAKES HOP AND BARLEY CONFERENCE
2 MARCH 2017

CHARLIE ROHWER
UNIVERSITY OF MINNESOTA
SOUTHERN RESEARCH & OUTREACH CENTER, WASECA, MN
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Selecting hop varieties for your location

What brewers want

What growers want
Why breed hops here?
Why breed hops here?
Hops are photoperiodic
Why breed hops *here*?

*Here* is not *there*
Let's Get It On

Phillip Reinagle - Cupid Inspiring the Plants with Love
Let’s Get it On
Hops are Dioecious
Hops are **Dioecious**
Let’s Get It On
Hops make seeds
Hops make seeds
Hop Breeding

1. Set goals
2. Select parents
3. Make crosses
4. Select seedlings
5. Single-hill selections
6. Multi-hill selections
7. Propagate and distribute
Does it grow OK at all?
Does it grow OK at all?

Is it female and perhaps what I am looking for?
Does it grow OK at all?

Is it female and perhaps what I am looking for?

Does it seem to grow consistently well?
Does it grow OK at all?

Is it female and perhaps what I am looking for?

Does it seem to grow consistently well and have decent chemistry?

Does it continue to grow well, and is the chemistry / brewing good?
Does it grow OK at all?

Is it female and perhaps what I am looking for?

Does it seem to grow consistently well and have decent chemistry?

Does it continue to grow well, and is the chemistry / brewing good?

Still good growing and brewing? Better than / different from anything else?
Does it grow OK at all?

Is it female and perhaps what I am looking for?

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Is it female and perhaps what I am looking for?

Does it seem to grow consistently well and have decent chemistry?

Does it continue to grow well, and is the chemistry / brewing good?

Still good growing and brewing? Better than / different from anything else?

Make more!!!
1. Set goals
2. Select parents
3. Make crosses
4. Select seedlings
5. Single-hill selections
6. Multi-hill selections
7. Propagate and distribute

> 10 YEARS
Where to get parents?

- Females
  - You already have them
Where to get parents?

- **Females**
  - You already have them
  - Find them
Where to get parents?

- Males
  - Find them

John Thull, UMN
Where to get parents?

- Males
  - Find them
  - Grow from seed
Tips

• Choose at least 1 vigorous parent
Tips

- Chose parents that are not closely related (as far as you know)
1. Open pollination (“OP”)  
--- OR ---  
2. Directed cross
Fig. 1. Pollen collection. (a) Plexiglas cylinder, with male flowers shedding pollen. (b) Layer of fresh pollen deposited on wax paper; debris, flowers, and occasional insects (irregular tracks) should be removed before collecting pollen in vial. (c) Desiccator with freshly collected pollen sample.
Seedlings...
Seedlings...in the field
Seedlings...in the field
Can't win them all...
### 2016 data:
1201, 1401, 1402, 1403 family selections

<table>
<thead>
<tr>
<th>ID</th>
<th>pedigree</th>
<th>harvest date</th>
<th>lb / string</th>
<th>% alpha</th>
<th>% CoH</th>
<th>notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1202-001</td>
<td>Nugget × HRC-DIM</td>
<td>6 Sept</td>
<td>1.19</td>
<td>5.0-5.7</td>
<td>48-50</td>
<td>Huge plant, <strong>easy to grow</strong>, some cone browning &amp; shatter (disease), <strong>interesting aroma</strong></td>
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<tr>
<td>1401-056</td>
<td>Brewer's Gold × USDA 19173M</td>
<td>11 August</td>
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<tr>
<td>1402-008</td>
<td>Sterling × 1204-001M (Sterling // Spalter Select / HRC-01M)</td>
<td>29 August</td>
<td>5.3</td>
<td>33</td>
<td></td>
<td>Large branches, small cones. <strong>Fresh and clean aroma. Dwarf traits.</strong></td>
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<tr>
<td>1402-028</td>
<td>17 August</td>
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## 2016 data:

**I201, I401, I402, I403 family selections**

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<td>I401-056</td>
<td>Brewer's Gold × USDA 19173M</td>
<td>11 August</td>
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<td>I402-008</td>
<td>Sterling × I204-001M (Sterling // Spalter Select / HRC-DIM)</td>
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• 4 putative Fuggle triploids from 2015 (Willamette sisters)
• 5 unique males

Seeds germinating in 2017:
- Sorachi Ace × (Chinook male)
- Southern Brewer × (Spalter Select male)
- Chinook × (Spalter Select male)
- 1402-028 × DP
  - [Sterling × (Spalter Select × HRC-DIM)] × ??
Status of hops at the U

- Wild hops?...

Angela Orshinsky

Josh Havill
Status of hops at the U

- Unique genetics?

Changbin Chen
UMN Horticulture
What would Butch Cassidy do?

Butch Cassidy, co-owner of Cassidy Hop Ranches
What would Butch Cassidy do?

Patent the plants?

- **PRO**
  - Quality control
  - Market control
  - ROI, $
What would Butch Cassidy do?

Patent the plants?

- **PRO**
  - Quality control
  - Market control
  - ROI, $

- **CON**
  - $ for patent, marketing
  - Must be willing to defend it

Butch Cassidy, co-owner of Cassidy Hop Ranches
IN SUMMARY

- **Breeding and Selection**: Making and choosing new combinations of DNA to meet the needs of growers and brewers.
  - Oh man, that’s slow...

- **Patenting and Branding**: won’t be going away any time soon.
Questions?

rohw0009@umn.edu
507-837-5647

Why are you wearing a tux?! 

It's after 6:00. What am I, a farmer?

SROC  Southern Research and Outreach Center

University of Minnesota

Driven to Discover™

Minnesota Agricultural Experiment Station

University of Minnesota
So a hop breeder takes his new variety into a bar...

Release the plants for anyone to grow

- **PRO**
  - Breeder can get $ from selling rhizomes
  - If it’s a great hop, brewers and growers can have as much as they want!

- **CON**
  - Anyone can get $ from selling cuttings
So a hop breeder takes his new variety into a bar...

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<th>Patent the plants</th>
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<td>• Breeder can get $ from selling rhizomes</td>
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<td>• Market control</td>
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<td></td>
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Marketing is necessary for patented hops

- High demand = better return
Let’s Get It On

• Goals
  o Yield?
  o Diseases?
  o Height?
  o Fertilizer use?
  o Irrigation efficiency?
  o Color?
  o Alpha & Beta?
What would Butch Cassidy do?

Maybe breweries would want to buy a hop I develop.

Butch Cassidy, co-owner of Cassidy Hop Ranches
What would Butch Cassidy do?
Butch Cassidy Ranches, 1st and 2nd year trellis
Butch Cassidy Ranches, advanced lines
BC199 samples in the kettle
BC199 is good, brewers want the hops

What should happen to these BC199 plants?

a) Sell some to neighbors so anyone can grow them
b) Patent the plants so I can control what happens to them
**Noble**
- Mt. Hood, Hall, Mfr.
- Fuggle, Strisselspalt, Sp. Select
- Spalter, Saazer, Tettnanger

**Northern Brewer**
- Hall, Tradition, Perle
- Northern Brewer, Challenger, Vojvodina, Viking
- First Gold, Zenith

**Some Alpha**
- Yeoman
- Horizon

**Source:** Seefelder et al., 2000
Principles of Parent Selection

• “It would behoove hop breeders to maximize heterozygosity when developing new varieties.”
  - J. Henning et al., 2004
Why breed hops in MN?

Cumulative hop cultivar releases

Origin:
- Pacific Northwest US
- Japan, South Africa, Other Europe
- Australia & New Zealand
- Germany
- England

Hop cultivar releases by year

1920 1940 1960 1980 2000

HOPS
Cumulative hop cultivar releases

Checkbox: Unavailable due to legal protections?
- yes
- no

Origin:
- Pacific Northwest US (sky blue)
- Japan, South Africa, Other Europe (red)
- Australia & New Zealand (light blue)
- Germany (orange)
- England (dark gray)

Hop cultivar releases by year

Timeline:
- 1920
- 1940
- 1960
- 1980
- 2000
1401

Brewer’s Gold

BB1 (Manitoba)

?
1401

19173M

Strisselspalter

Cluster seedling
**Objective:** something like Brewer’s Gold, but easier to pick.
**Noble**
- Mt. Hood, Hall, Mfr.
- Fuggle, Strisselspalter, Sp. Select
- Spalter, Saazer, Tettnanger

**Northern Brewer**
- Hall, Tradition, Perle
- Northern Brewer, Challenger, Vojvodina, Viking
- First Gold, Zenith

**Some Alpha**
- Yeoman
- Horizon

Source: Seefelder et al., 2000
Selecting hops for Ohio

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<tr>
<th>Yakima Gold</th>
<th>Mandarina Bavaria</th>
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<tr>
<td>Cashmere</td>
<td>Jaryllo</td>
</tr>
<tr>
<td>Tahoma</td>
<td>Azacca</td>
</tr>
<tr>
<td>Triple Pearl</td>
<td>El Dorado</td>
</tr>
<tr>
<td>Newport</td>
<td>Equinox</td>
</tr>
</tbody>
</table>

| Equinox            | Jaryllo          |
| Citra              | Azacca           |
| Mosaic             | El Dorado        |
| Simcoe             | Equinox          |
| Amarillo           | Belma            |
| Ahtanum            | Delta            |
| Hull Melon         | Galaxy           |
| Hallertau Blanc    | Lemon Drop       |
| Nelson Sauvin      |                  |

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Selecting hops for Indiana

Yakima Gold
Cashmere
Tahoma
Triple Pearl
Newport

USDA & WSU

Equinox
Citra
Mosaic
Simcoe
Amarillo
Ahtanum
Hull Melon
Hallertau Blanc
Nelson Sauvin

Mandarina Bavaria
Jaryllo
Azacca
El Dorado
Equinox
Belma
Delta
Galaxy
Lemon Drop

Private breeding

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Pre-stratified, ready to germinate hop breeding starter kit

What I plan to do with 1403

- Select vigorous females with high yield potential for further evaluation. Early maturation?
Pre-stratified, ready to germinate hop breeding starter kit

What I plan to do with 1403

- Select vigorous females with high yield potential for further evaluation. Early maturation?
- Select a vigorous, floriferous, disease-tolerant male for further breeding
  - × Challenger
  - × Yeoman
Days with rainfall >0.1” (%, since 1981)

Source: Western Regional Climate Center, wrcc.dri.edu
Days with rainfall >0.1” (%) since 1981

Source: Western Regional Climate Center, wrcc.dri.edu
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Tips

- Healthy mother = better germination
- Old seed = difficult germination