

Hop Breeding:

Let's Get It On

GREAT LAKES HOP AND BARLEY CONFERENCE

2 MARCH 2017



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SOUTHERN RESEARCH & OUTREACH CENTER, WASECA, MN



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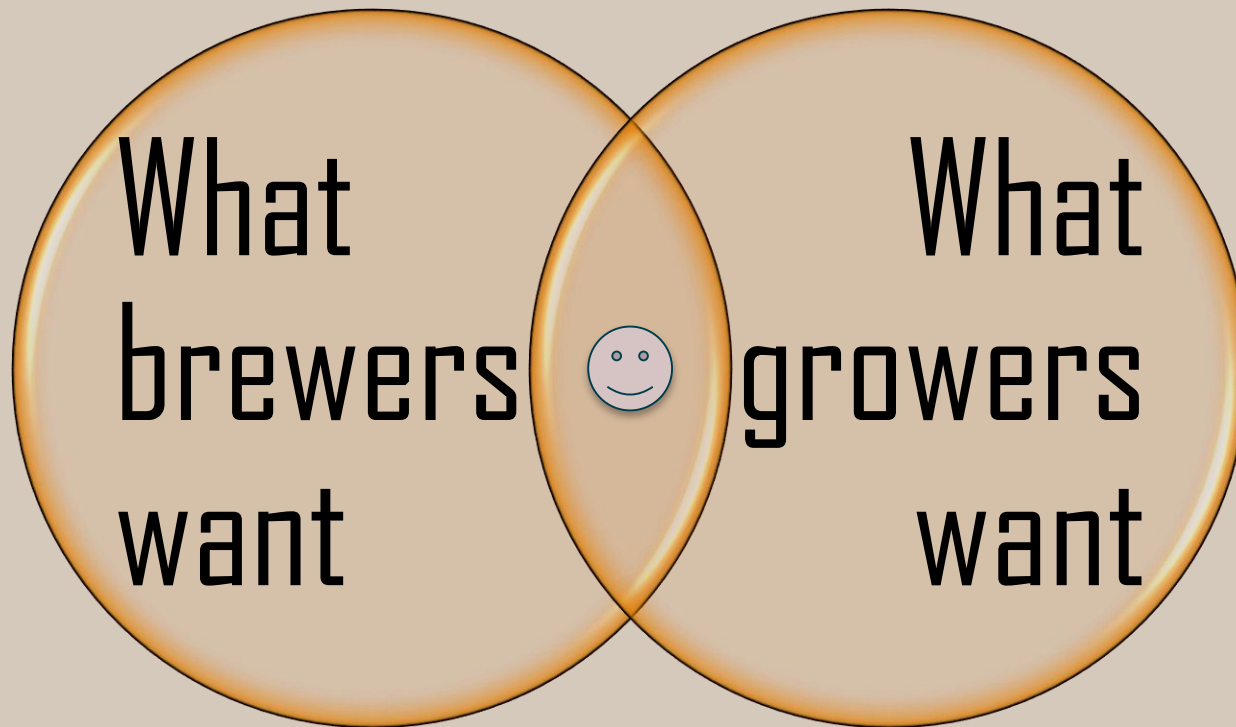
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Selecting hop varieties for your location



Why breed hops *here*?



M
HOPS

Why breed hops *here*?

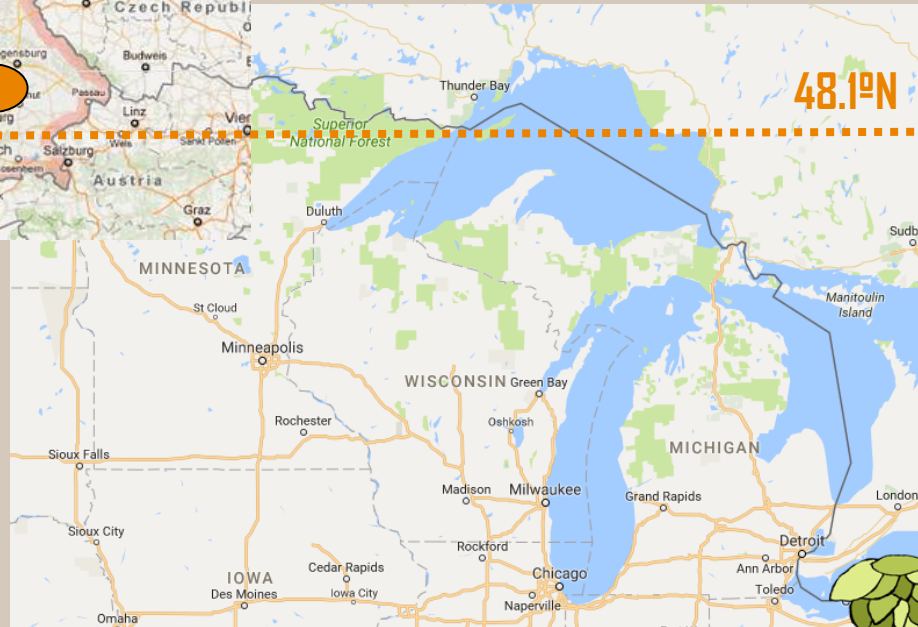
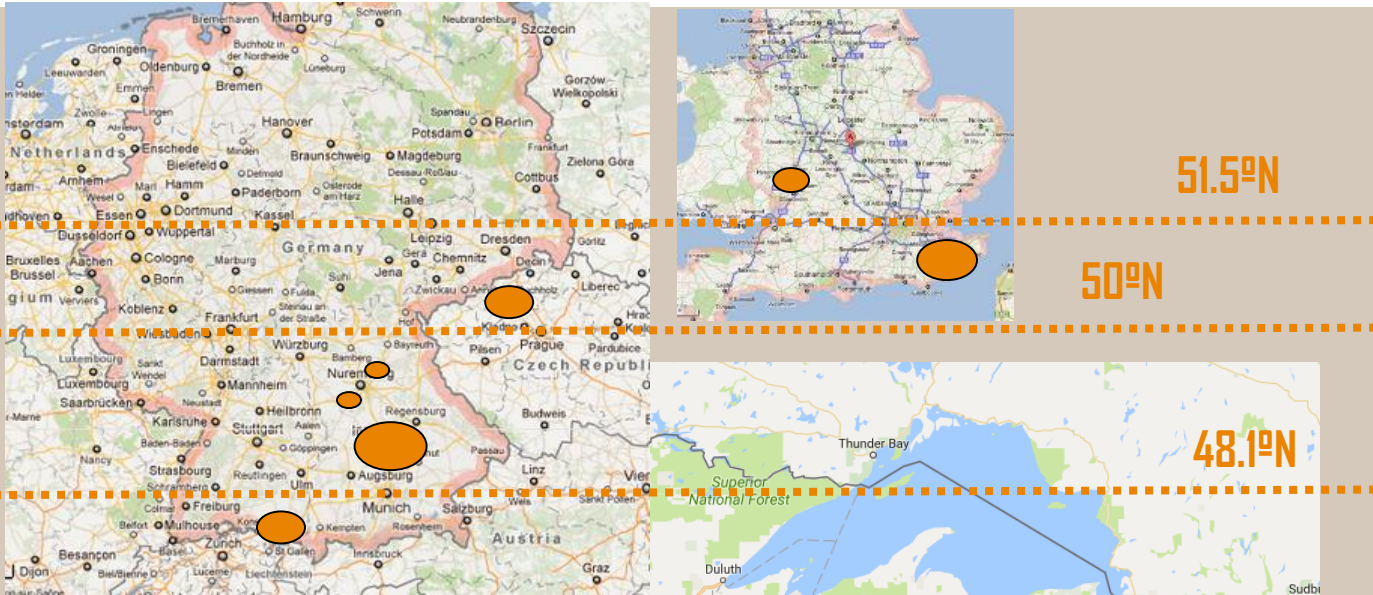


Breeding...

and *SELECTION*



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



Hops are Dioecious



HOPS

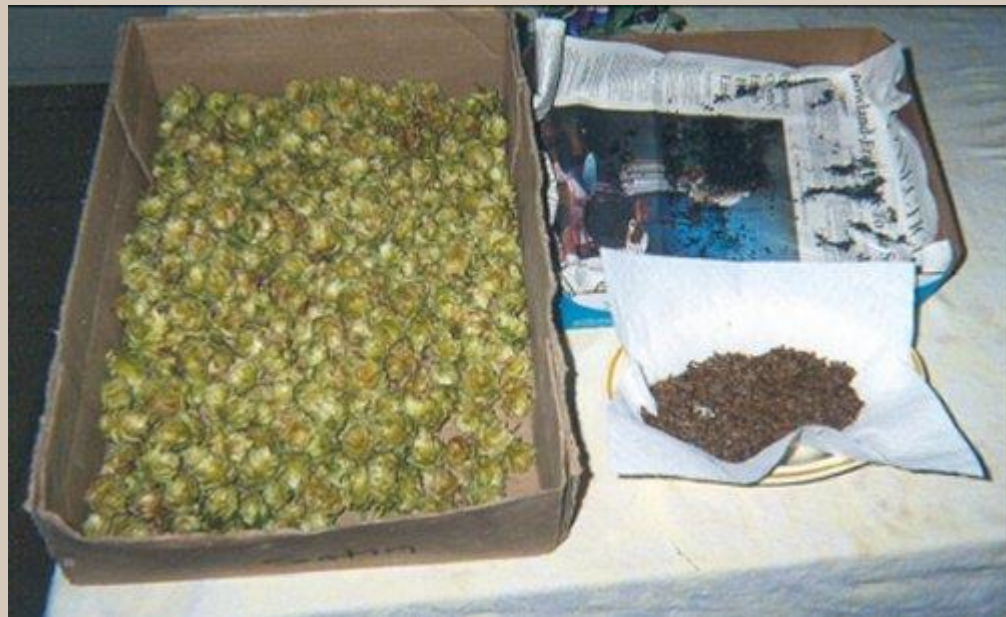
Let's Get It On



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?



HOPS



↓ Does it grow OK at all?



↓ Is it female and perhaps what I am looking for?



HOPS



↓ Does it grow OK at all?



↓ Is it female and perhaps what I am looking for?



↓ Does it seem to grow consistently well?



HOPS



↓ 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?



HOPS



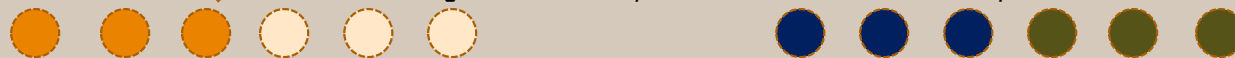
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↓ Does it continue to grow well, and is the chemistry / brewing good?



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





↓ Does it grow OK at all?



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



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



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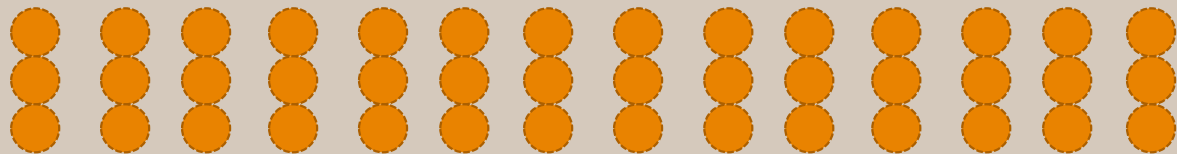
↓ Does it continue to grow well, and is the chemistry / brewing good?



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



↓ Make more!!!



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



> 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

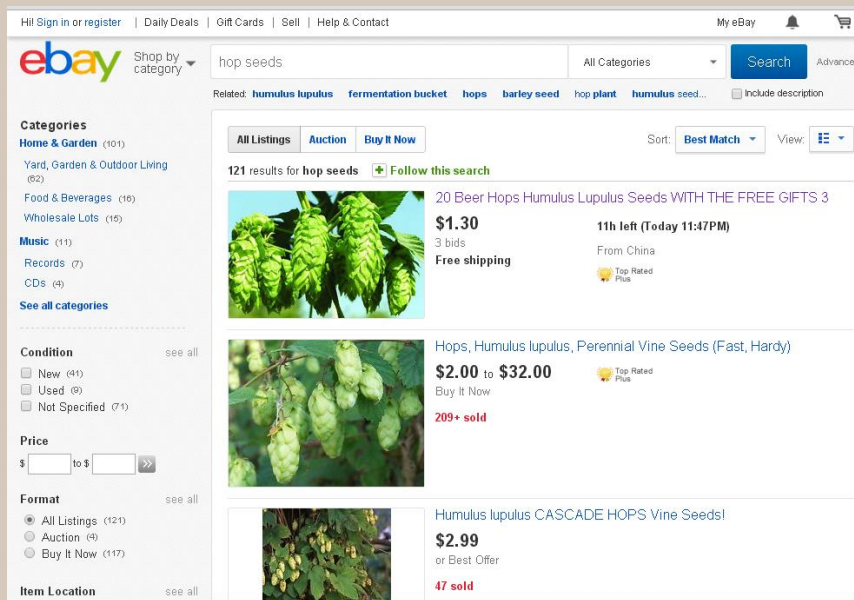


John Thull, UMN



Where to get parents?

- Males
 - Find them
 - Grow from seed



The screenshot shows an eBay search results page for "hop seeds". The search bar at the top contains "hop seeds" and the search button is labeled "Search". Below the search bar, there are filters for "Categories", "Condition", "Price", "Format", and "Item Location". The search results are sorted by "Best Match" and show 121 results for "hop seeds". The first result is "20 Beer Hops Humulus Lupulus Seeds WITH THE FREE GIFTS 3" priced at \$1.30, with 3 bids and 11 hours left. The second result is "Hops, Humulus lupulius, Perennial Vine Seeds (Fast, Hardy)" priced at \$2.00 to \$32.00, with 209+ sold. The third result is "Humulus lupulus CASCADE HOPS Vine Seeds!" priced at \$2.99 or Best Offer, with 47 sold. The page also includes a "Follow this search" button and a "Shop by category" dropdown menu.



Tips

- Choose at least 1 vigorous parent



1204-001M

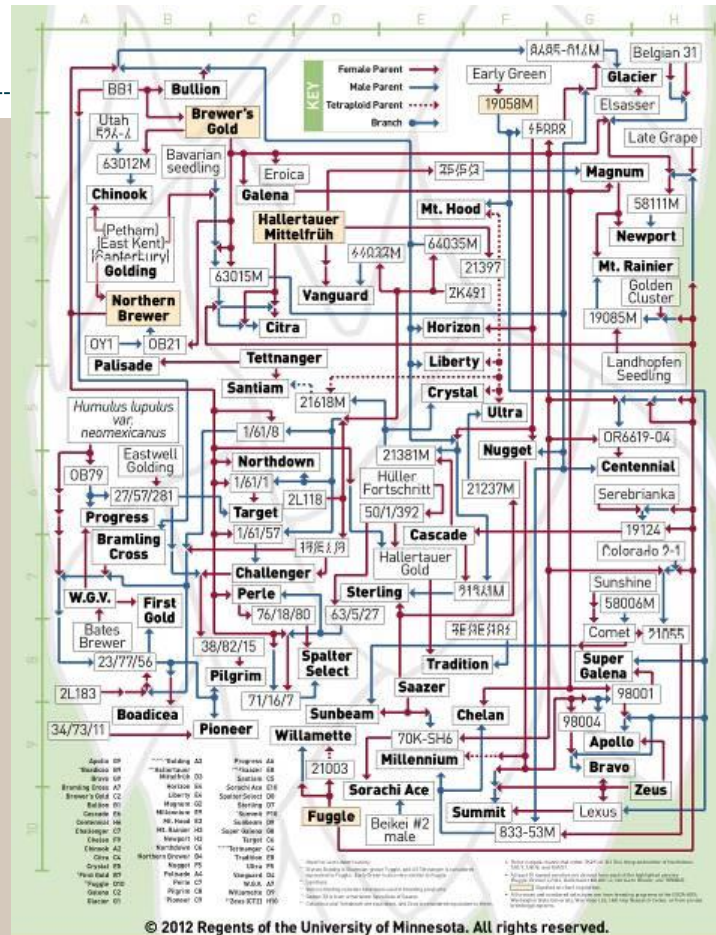


Tips

- Chose parents that are not closely related (as far as you know)



z.umn.edu/hoposter



PEDIGREES OF COMMON HOP VARIETIES

Hop pedigrees are interconnected and complicated but can be helpful for understanding existing varieties or for creating new varieties. Researchers at the University of Minnesota are studying hop varieties and production systems.

FOR MORE INFORMATION: z.umn.edu/hops

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Driven to Discover



1. Open pollination ("OP")

--OR--

2. Directed cross



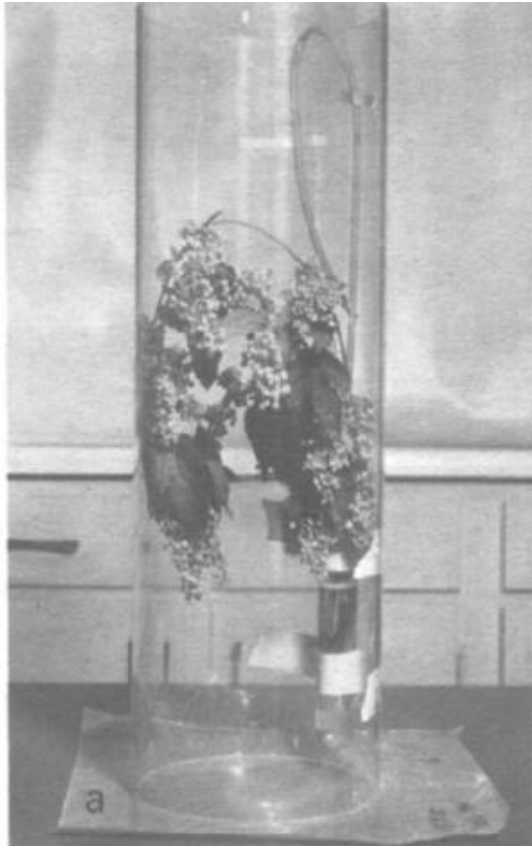


Fig. 1. Pollen collection. (a) Plexiglas cylinder, with male flowers shedding pollen. (b) Layer of fresh pollen deposited on wax paper; debris, flowers, and occasional insects (irregular tracks) should be removed before collecting pollen in vial. (c) Desiccator with freshly collected pollen samples.











Seedlings...



Seedlings...in the field



Seedlings...in the field





M
HOPS

Can't win them all...



2016 data:
 1201, 1401, 1402, 1403 family selections

ID	pedigree	harvest date	lb / string	% alpha	% CoH	notes
1202-001	Nugget × HRC-DIM	6 Sept	1.19	5.0-5.7	48-50	Huge plant, easy to grow , some cone browning & shatter (disease), interesting aroma



1401			9.8	28	A bit difficult to pick, but early and smells interesting
1402			5.8	33	Large branches, small cones. Fresh and clean aroma. Dwarf traits.
1402			7.7	25	OK aroma. Dwarf traits.
1403			5.5	35	Light on lupulin and aroma
1403			9.7	24	Columnar habit with good branching. Interesting citrus-like aroma, fairly early, healthy cones.

2016 data:
1201, 1401, 1402, 1403 family selections

ID	pedigree	harvest date	lb / string	% alpha	% CoH	notes
1202-001	Nugget × HRC-DIM	6 Sept	1.19	5.0-5.7	48-50	Huge plant, easy to grow , some cone browning & shatter (disease), interesting aroma
1401-056	Brewer's Gold × USDA 19173M	11 August	0.93	9.8	28	A bit difficult to pick , but early and smells interesting
1402-008	Sterling × 1204-001M	29 August	1.49	5.3	33	Large branches, small cones. Fresh and clean aroma. Dwarf traits.
1402-028	(Sterling // Spalter Select / HRC-DIM)	17 August	1.15	7.7	25	OK aroma. Dwarf traits.
1403-005		17 August	1.26	5.5	35	Light on lupulin and aroma
1403-023	Sterling × USDA 19058M	11 August	0.95	9.7	24	Columnar habit with good branching. Interesting citrus-like aroma , fairly early, healthy cones.

2016 data:
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ID	pedigree	harvest date	lb / string	% alpha	% CoH	notes
1202-001	Nugget × HRC-DIM	6 Sept	1.19	5.0-5.7	48-50	Huge plant, brownish cones. Strong citrus-like aroma.
1401-056	Brewer's Gold × USDA 19173M	11 August	0.93	9.8	28	A bit different, but interesting.
1402-008	Sterling × 1204-001M	29 August	1.49	5.3	33	Large branches, small cones. Fresh and clean aroma. Dwarf traits.
1402-028	(Sterling // Spalter Select / HRC-DIM)	17 August	1.15	7.7	25	OK aroma. Dwarf traits.
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1202-001	Nugget × HRC-DIM	6 Sept	1.19	5.0-5.7	48-50	Huge plant, browning buds, aroma
1401-056	Brewer's Gold × USDA 19173M	11 August	0.93	9.8	28	A bit difficult to harvest, interesting
1402-008	Sterling × 1204-001M	29 August	1.49	5.3	33	Large branches, aroma . Dv
1402-028	(Sterling // Spalter Select / HRC-DIM)	17 August	1.15	7.7	25	OK aroma.
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1403-023		11 August	0.95	9.7	24	Columnar habit with good branching. Interesting citrus-like aroma , fairly early, healthy cones.



Status of hops at the U

- 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 × OP
 - ✦ [Sterling × (Spalter Select × HRC-01M)] × ??



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?



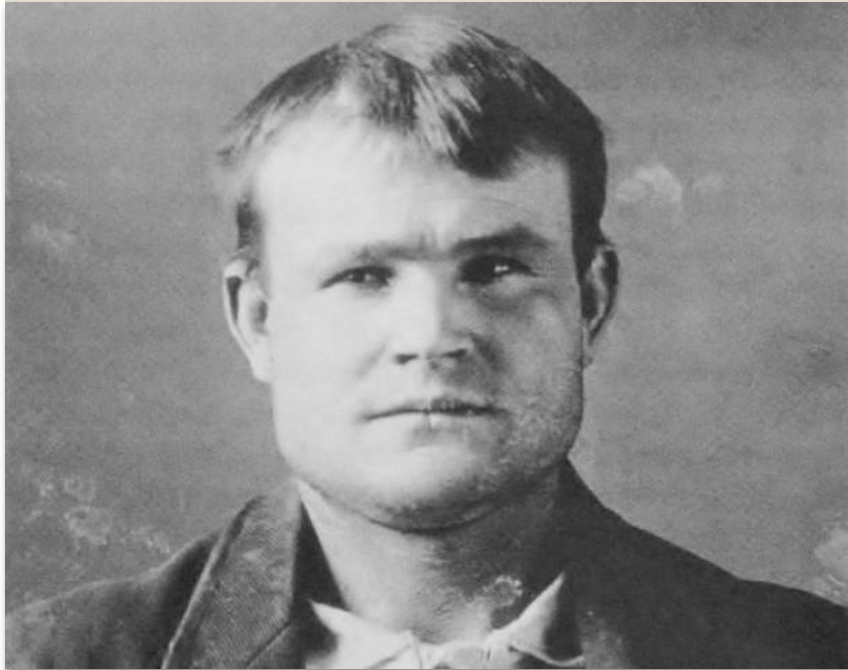
Butch Cassidy, co-owner of Cassidy Hop Ranches



What would Butch Cassidy do?



Patent the plants?



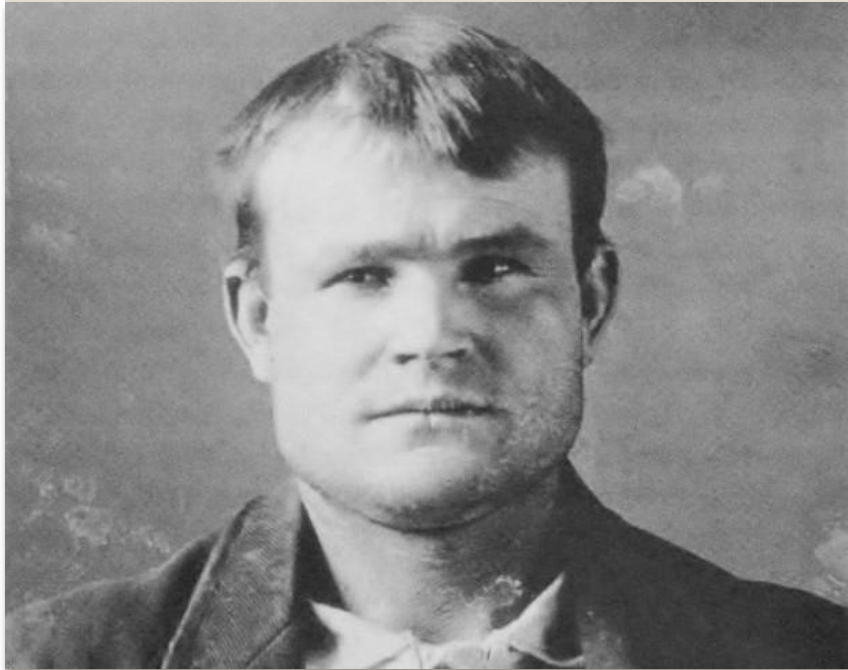
Butch Cassidy, co-owner of Cassidy Hop Ranches

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

What would Butch Cassidy do?



Patent the plants?



Butch Cassidy, co-owner of Cassidy Hop Ranches

- **PRO**
 - Quality control
 - Market control
 - ROI, \$
- **CON**
 - \$ for patent, marketing
 - Must be willing to defend it

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?

rohwo0009@umn.edu
507-837-5647

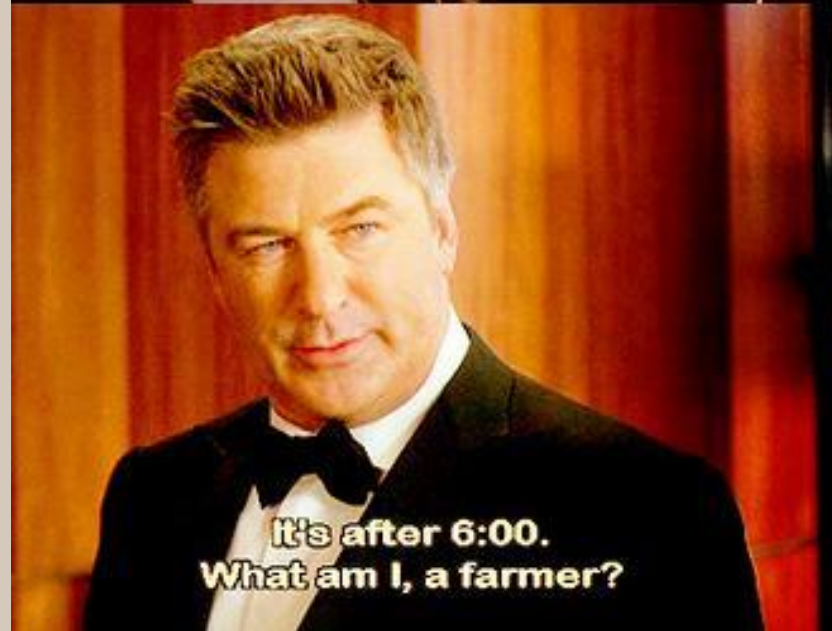


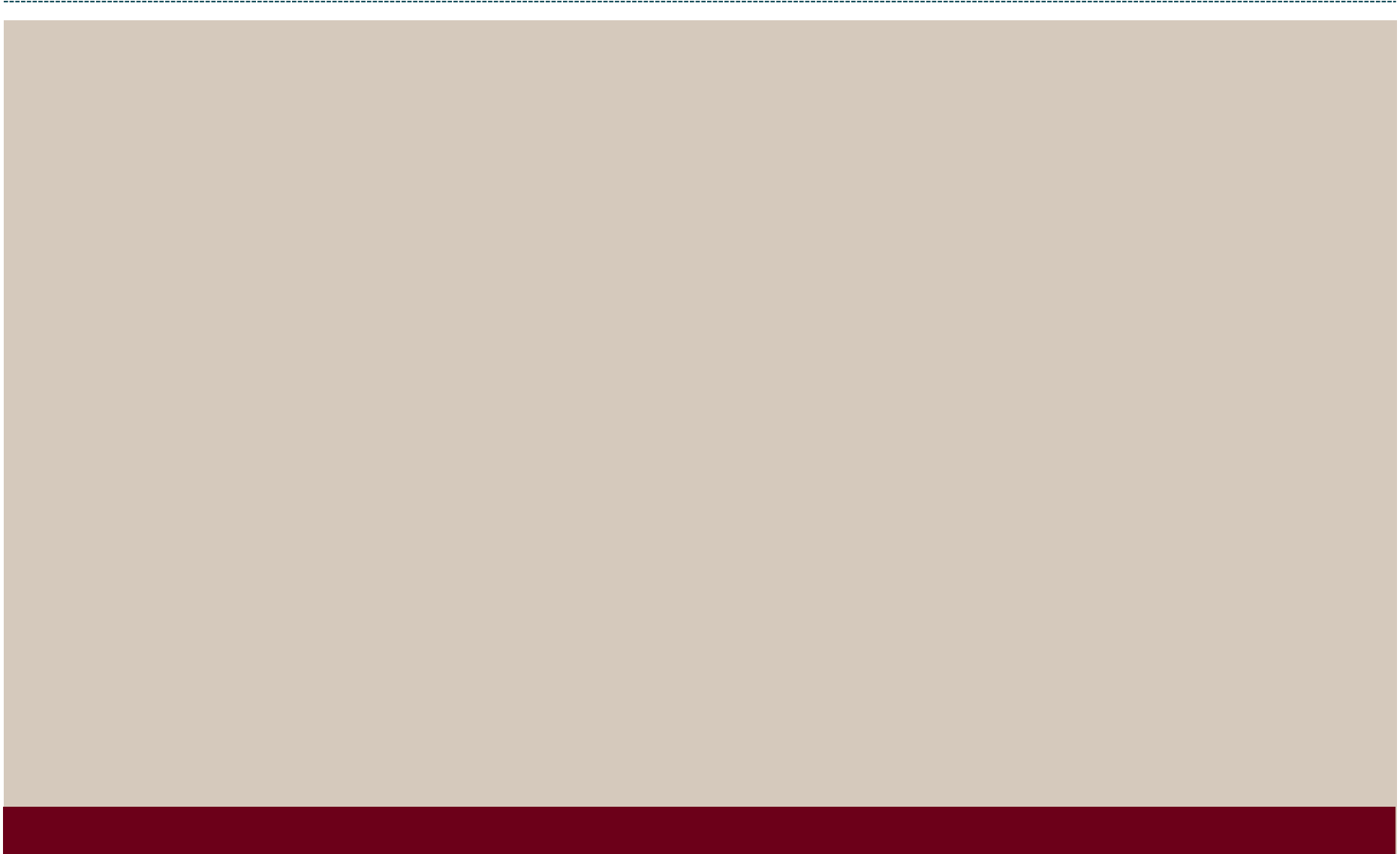
SROC Southern Research
and Outreach Center

UNIVERSITY OF MINNESOTA
Driven to DiscoverSM

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...



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

Patent the plants

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

Marketing is necessary for patented hops

- High demand = better return

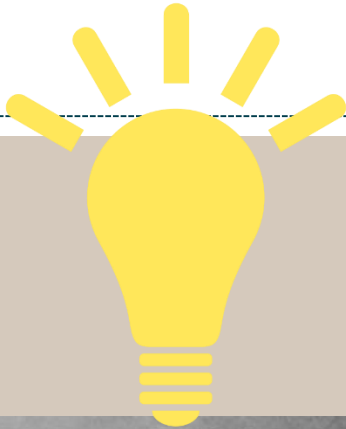


Let's Get It On

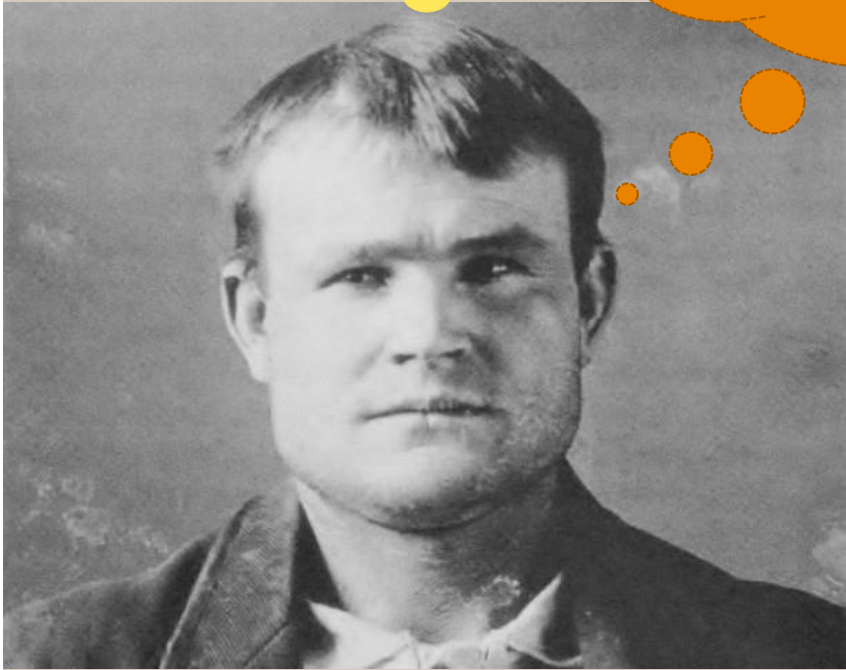
- Goals
 - Yield?
 - Diseases?
 - Height?
 - Fertilizer use?
 - Irrigation efficiency?
 - Color?
 - Alpha & Beta?



What would Butch Cassidy do?



Maybe breweries would want buy a hop I develop



Butch Cassidy, co-owner of Cassidy Hop Ranches

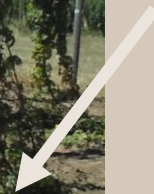
What would Butch Cassidy do?



Butch Cassidy Ranches, 1st and 2nd year trellis



BC199



M
HOPS

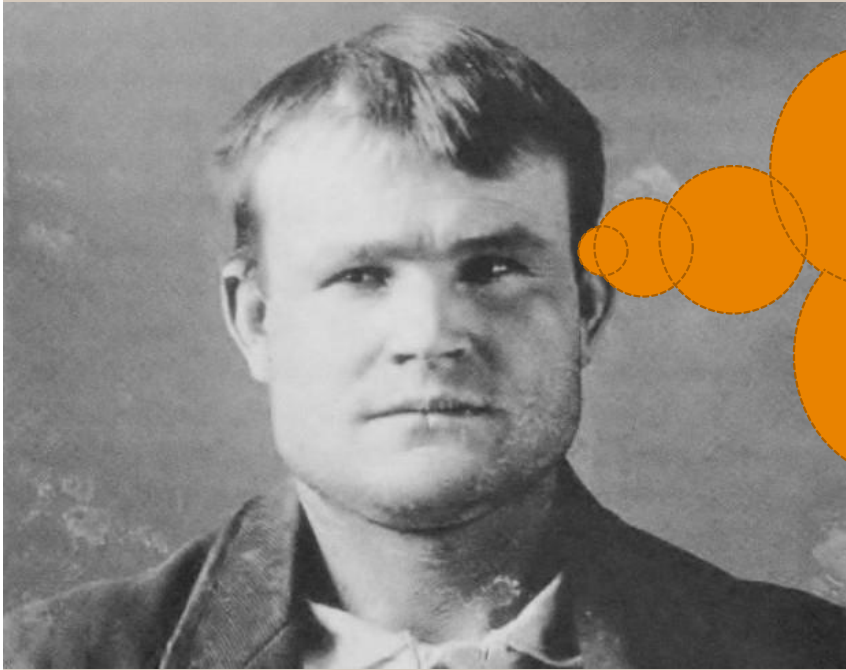
Butch Cassidy Ranches, advanced lines



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, Strisselspalter, Sp. Select

Spalter, Saazer, Tettnanger

Northern Brewer

Hall. Tradition, Perle

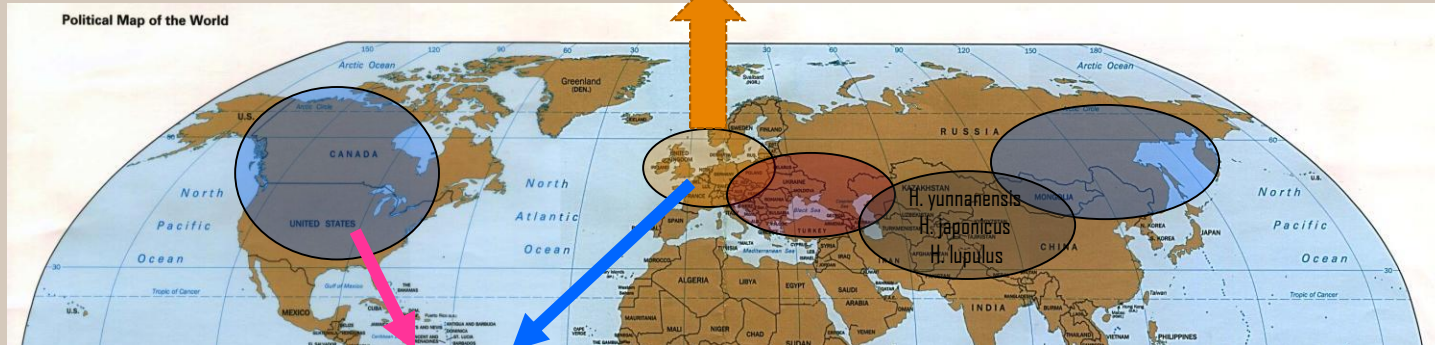
Northern Brewer, Challenger, Vojvodina, Viking

First Gold, Zenith

Some Alpha

Yeoman

Horizon



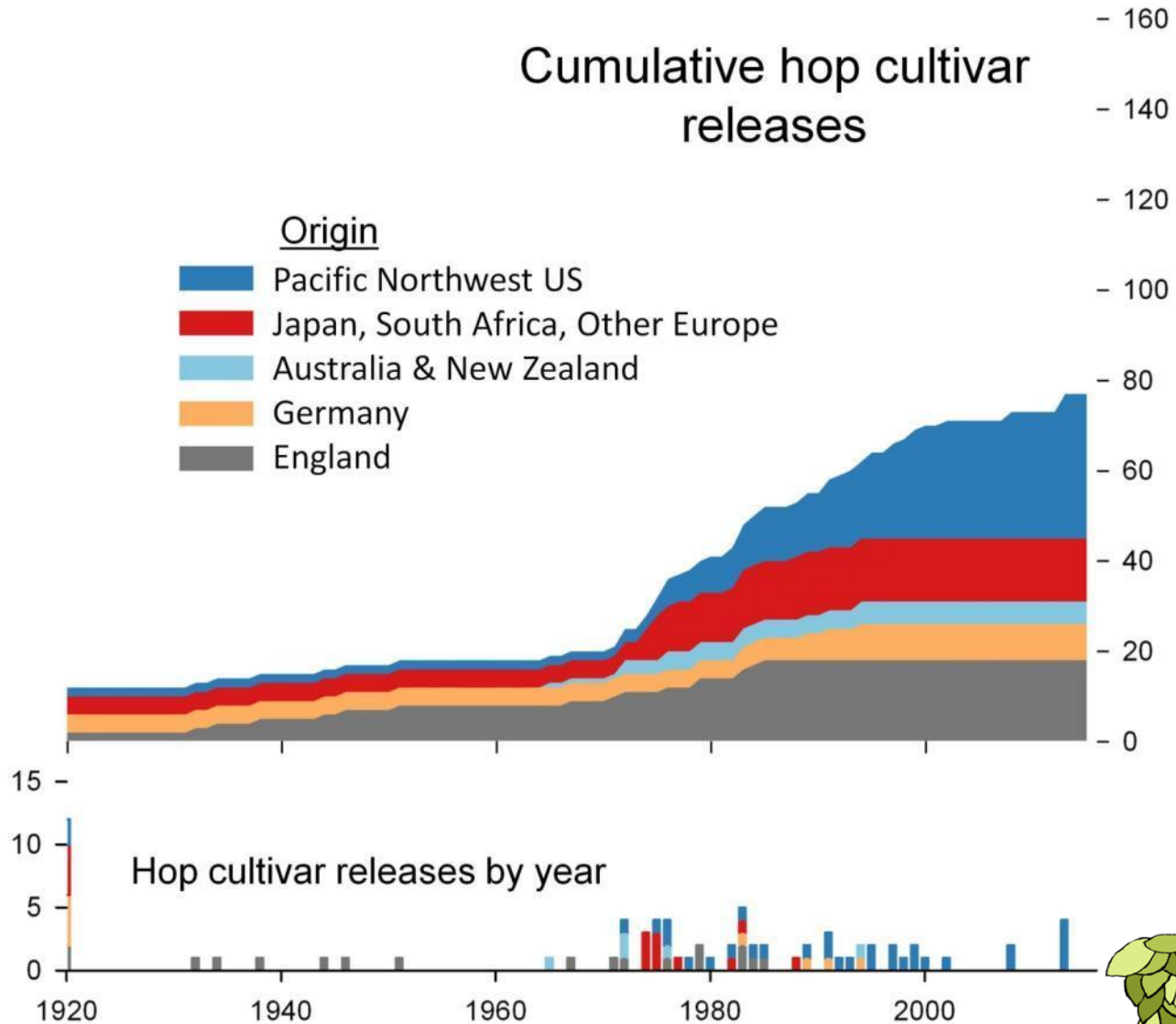
Principles of Parent Selection

- "It would behoove hop breeders to maximize heterozygosity when developing new varieties."

-J. Henning et al., 2004



Why breed hops in MN?

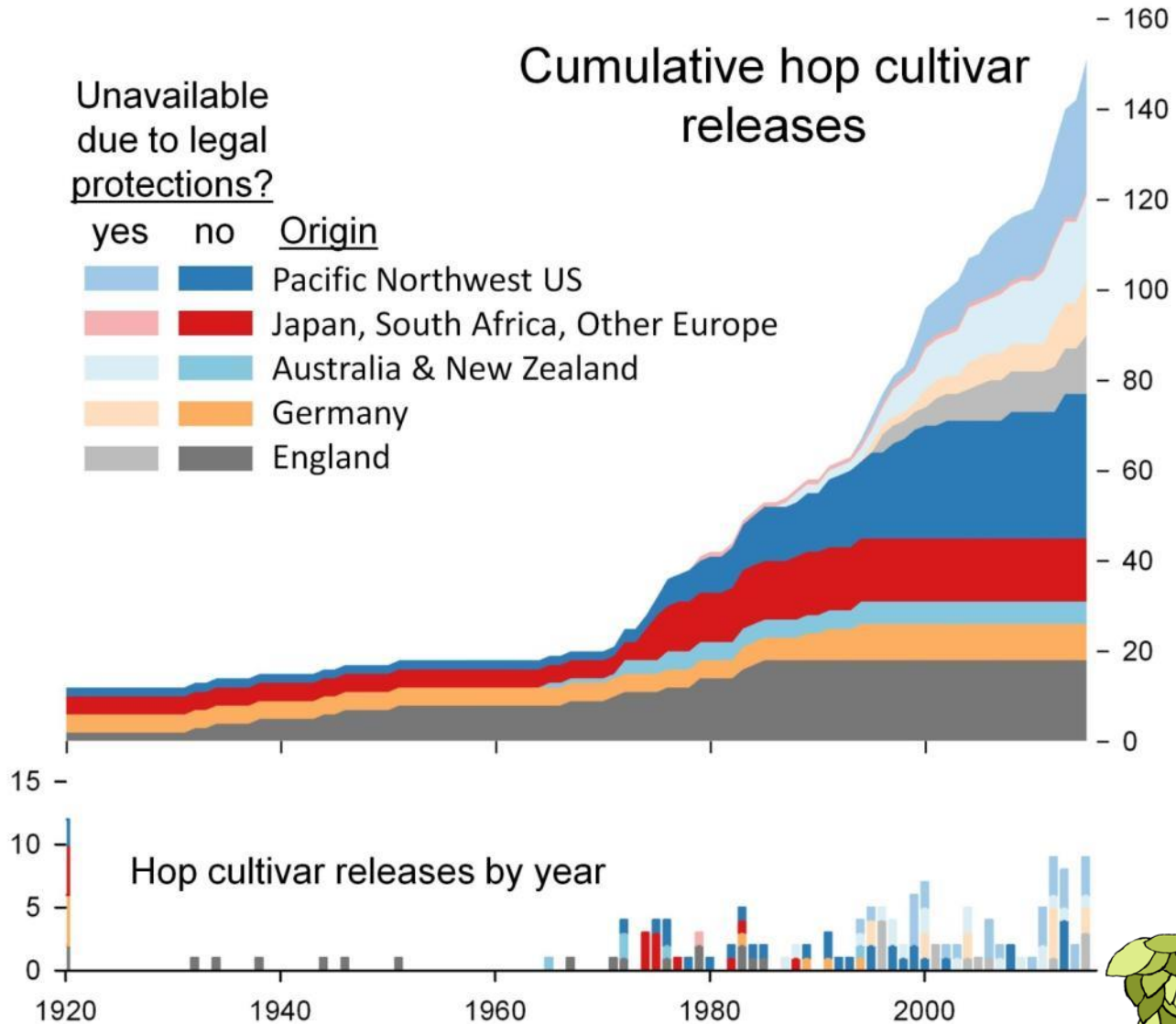


Unavailable
due to legal
protections?

yes no Origin

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

Cumulative hop cultivar releases



HOPS

1401

**Brewer's
Gold**

19173M



1401

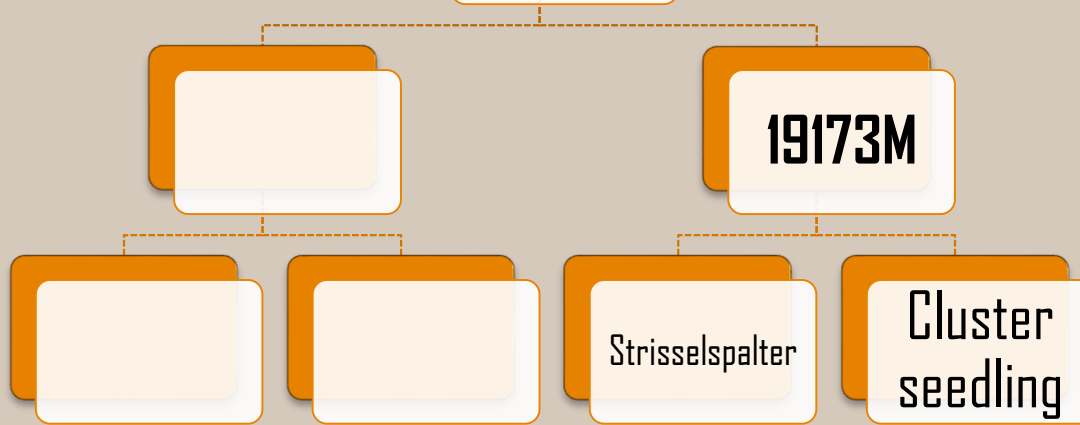
Brewer's
Gold

BB1
(Manitoba)

?



1401



1401

Brewer's
Gold

19173M

BB1
(Manitoba)

?

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

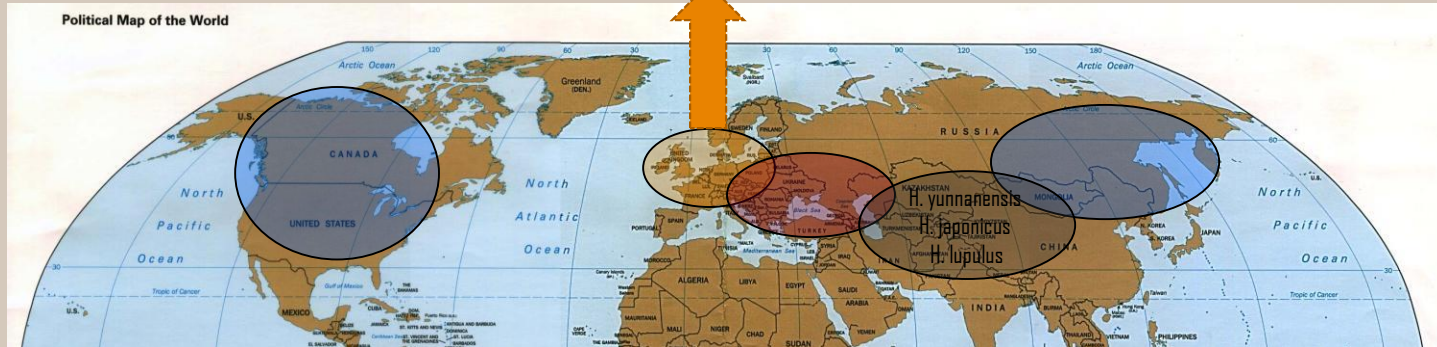
Northern Brewer, Challenger, Vojvodina, Viking

First Gold, Zenith

Some Alpha

Yeoman

Horizon





NA-EU

Cascade

Brewer's Gold, Galena, Columbus, Chinook

Cluster

Source: Seefeldt et al., 2000



Source: Seefeldt et al., 2000

Selecting hops for Ohio

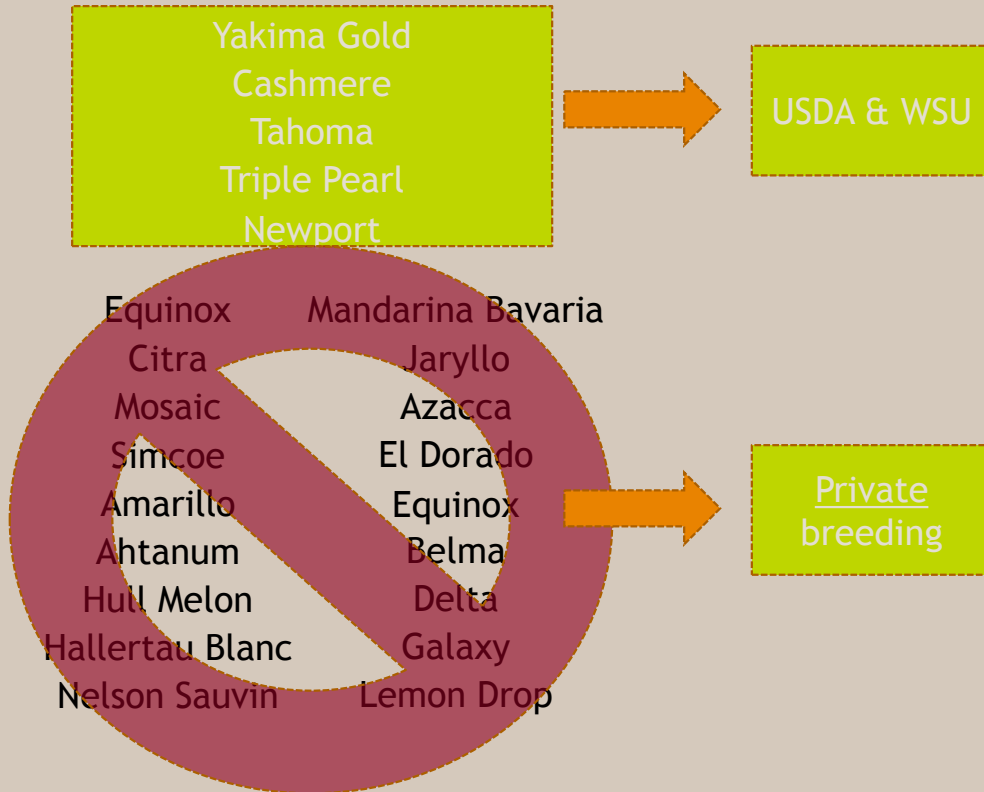
NEW!!

Yakima Gold
Cashmere
Tahoma
Triple Pearl
Newport

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

Selecting hops for Indiana

NEW!!



Pre-stratified, ready to germinate hop breeding starter kit

What / plan to do with 1403

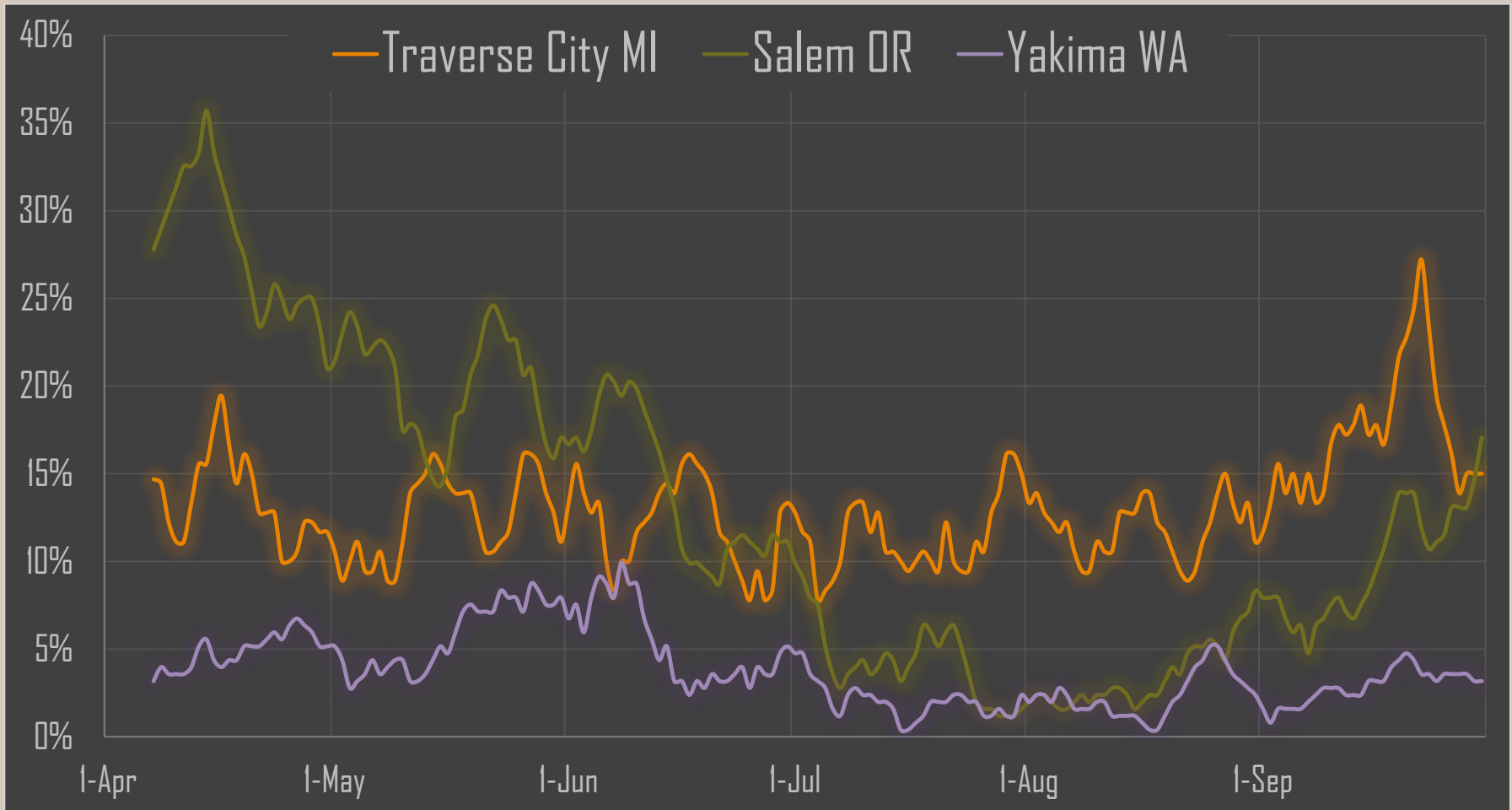
- Select vigorous females with high yield potential for further evaluation. Early maturation?

Pre-stratified, ready to germinate hop breeding starter kit

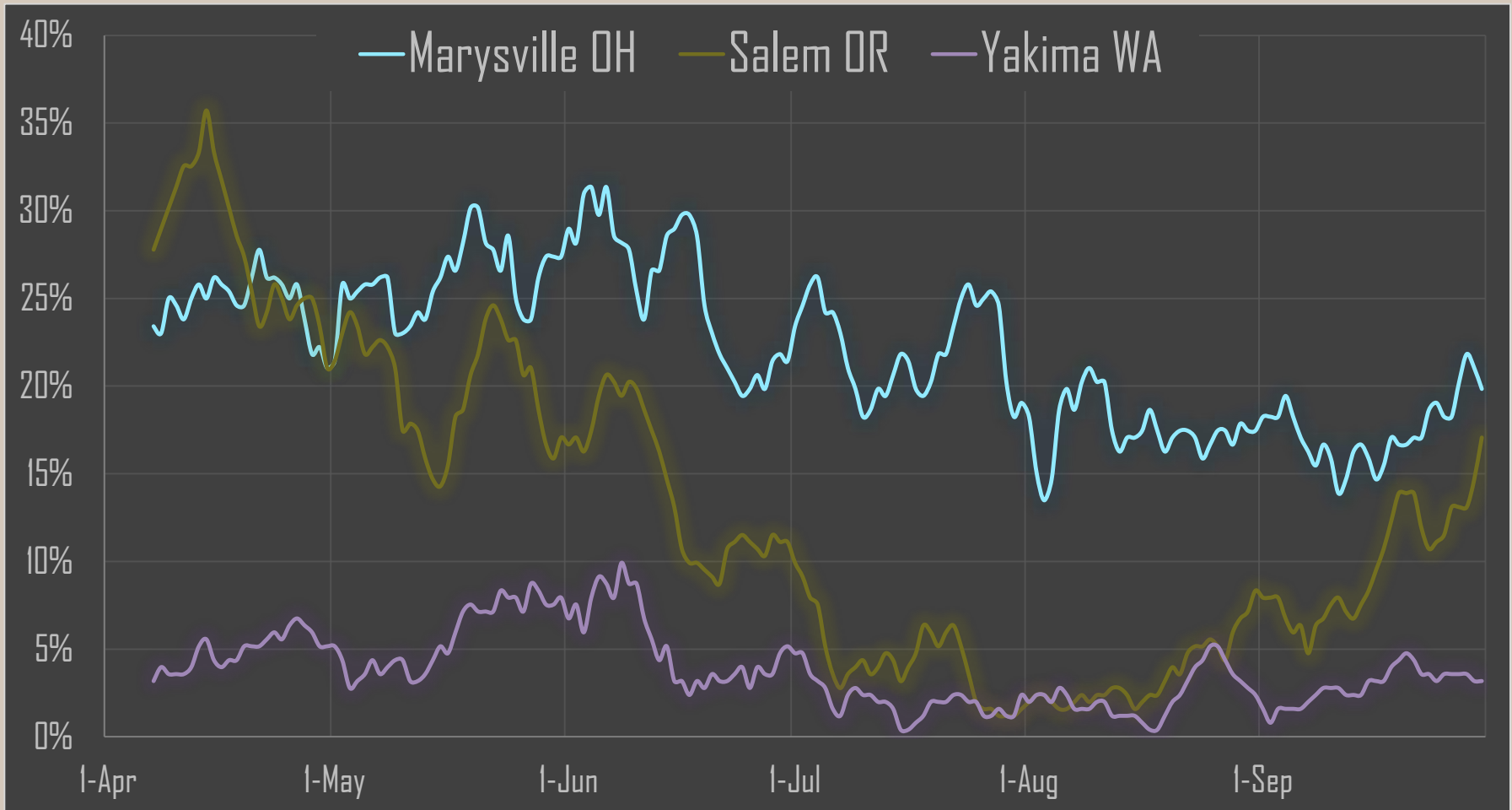
What / plan to do with 1403

- Select vigorous females with high yield potential for further evaluation. Early maturation?
- Select a vigorous, floriferous, disease-tolerant male for further breeding
 - × Challenger
 - × Yeoman

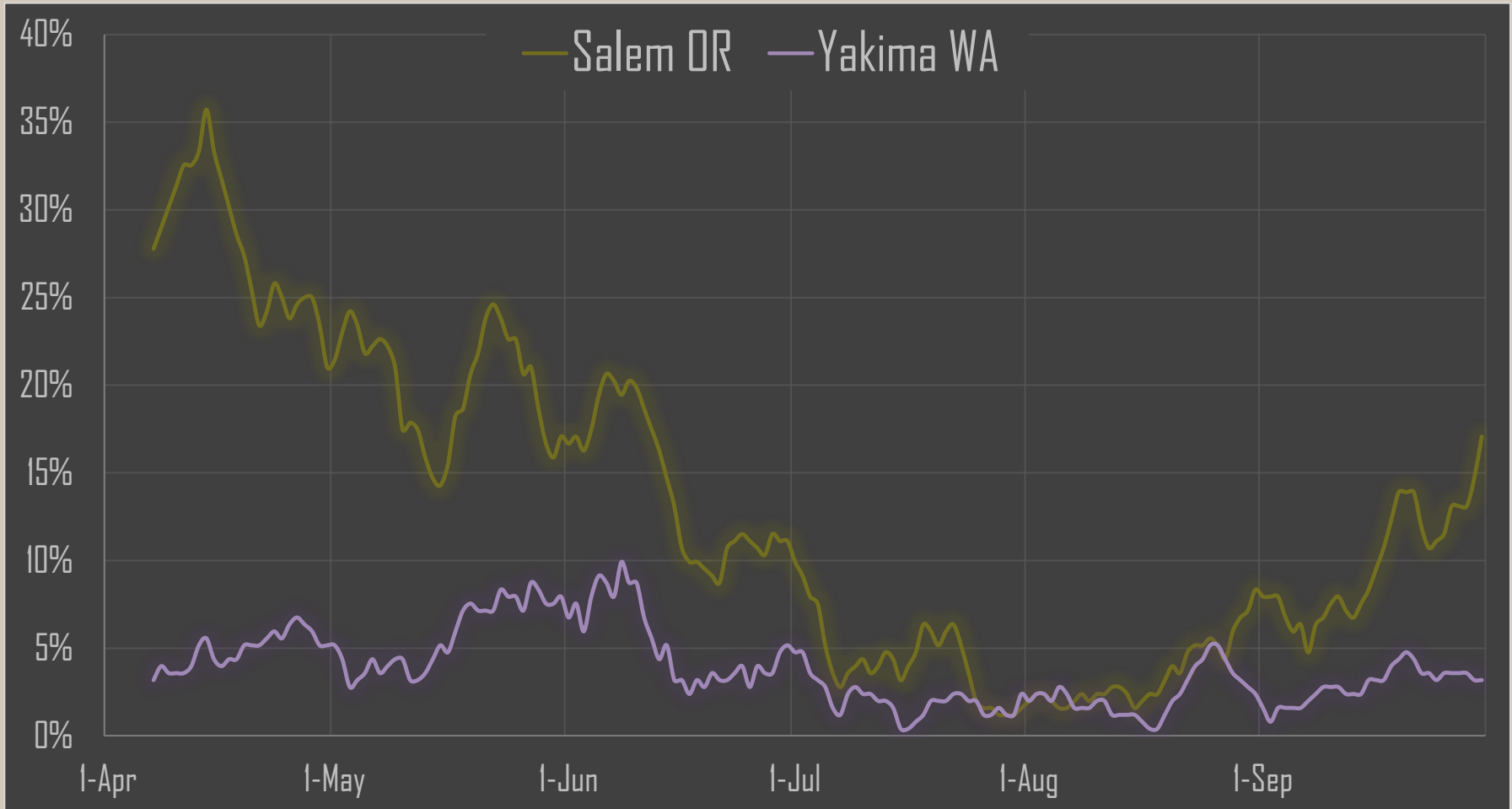
Days with rainfall >0.1" (% , since 1981)



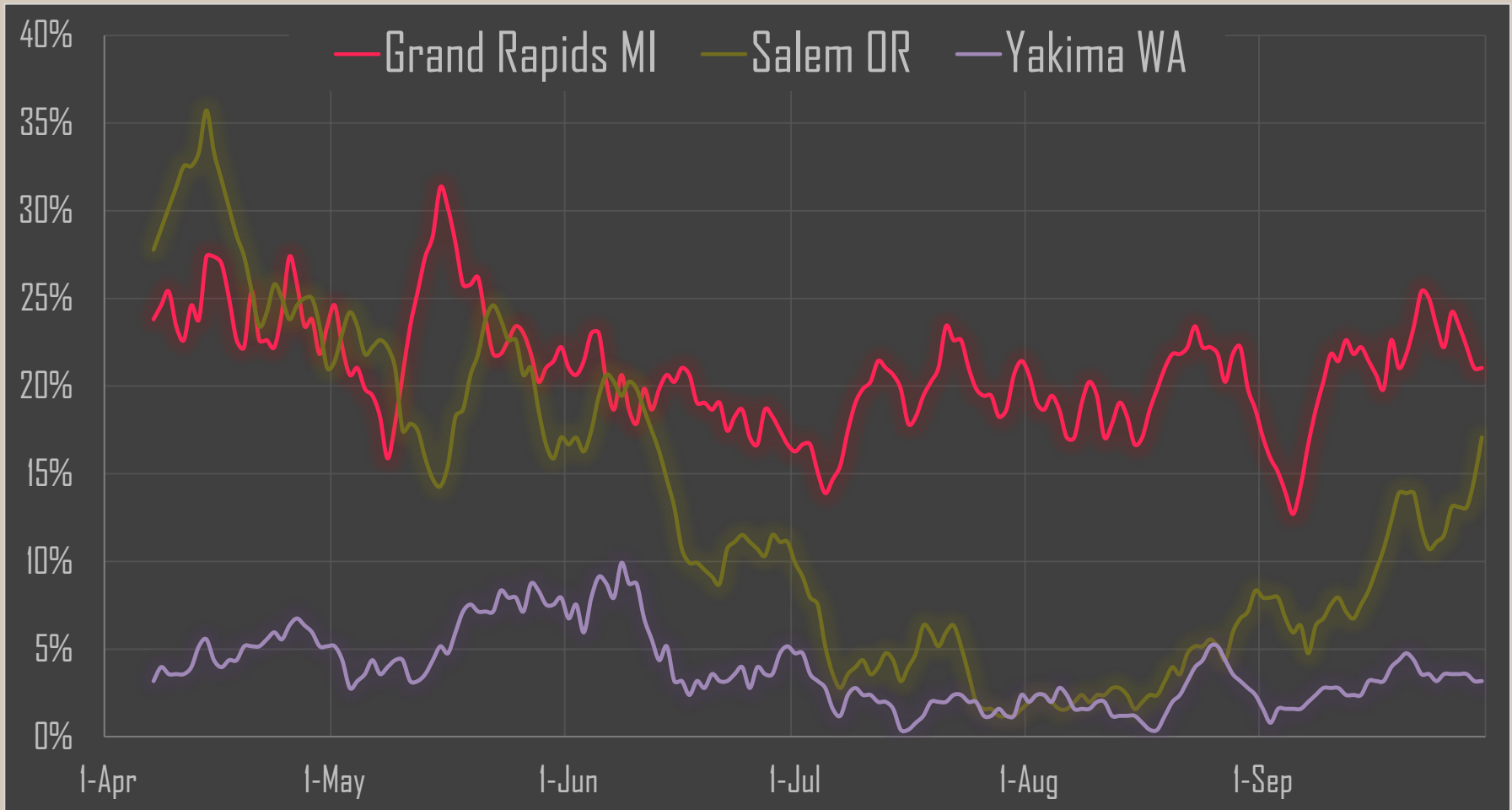
Days with rainfall >0.1" (% , since 1981)



Days with rainfall >0.1" (% , since 1981)



Days with rainfall >0.1" (% , since 1981)



Tips

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

