



**YAKIMA
CHIEF**
- HOPS -

YAKIMA CHIEF
Ranches



FROM PROPAGATION TO PINT:

BREEDING 101: CREATING, GROWING, AND PROTECTING VALUE

JOE CATRON

VP, Footprints-YAKIMA CHIEF RANCHES

TODAY'S PRESENTATION

- IMPORTANCE OF HOP BREEDING PROGRAMS
- BACKGROUND ON YAKIMA CHIEF RANCHES (YCR)
- YCR HOP BREEDING DEVELOPMENT CYCLE
- FOOTPRINTS® BRAND MANAGEMENT PROGRAM
- YCR / HBC HOP BRANDS
- THE ROLE OF YAKIMA CHIEF HOPS (YCH)
- UNDERSTANDING AROMA
- Q&A WITH JASON AND RYAN



OUR MISSION

To connect family hop farms to the world's finest brewers

OUR VISION

We are the global supplier of choice, focused on sustainably produced, innovative hop products. We are a responsible neighbor and asset to our communities, enriching the products, businesses and lives of everyone we encounter.

OUR VALUES

- **Passion:** For people, product, planet and process
- **Respect:** Teamwork and collective responsibility
- **Integrity:** Transparency and accountability in all we do
- **Dedication:** Quality and sustainability
- **Excellence:** An emphasis on innovation and continuous improvement

GROWERS

We are the only 100% grower owned hop company. Our grower families have been harvesting hops in the Northwest since the 1800s and have acquired a wealth of knowledge and expertise throughout the decades to create the highest quality hops.

These grower-owners include:

- 3D Farm/BC Hop Farm
- Brulotte Farms
- B.T. Loftus Ranches
- C&C Hop Farms
- Carpenter Ranches
- Gasseling Ranches
- Perrault Farms
- Sauve & Son Farms
- Sodbuster Farms
- Van Horn Farms



In addition to our grower owners, we receive hops from an additional 43 families throughout the Pacific Northwest.

YAKIMA CHIEF RANCHES

- STARTED IN 1980 BY THREE HOP FARMING FAMILIES FOCUSED ON BRINGING THE BEST AMERICAN HOPS TO THE WORLD'S BREWERS
- MISSION TO **CREATE, GROW AND PROTECT VALUE** FOR ALL WITHIN THE YCR FOOTPRINT
- JASON PERRAULT BECOMES PROTÉGÉ OF RENOWNED HOP BREEDER CHUCK ZIMMERMAN

YAKIMA CHIEF®
—Ranches—



THE CONNECTION OF PROPAGATION TO PINT

YAKIMA CHIEF HOPS (YCH)

YAKIMA CHIEF
Ranches



QUALITY & SUPPLY MANAGEMENT



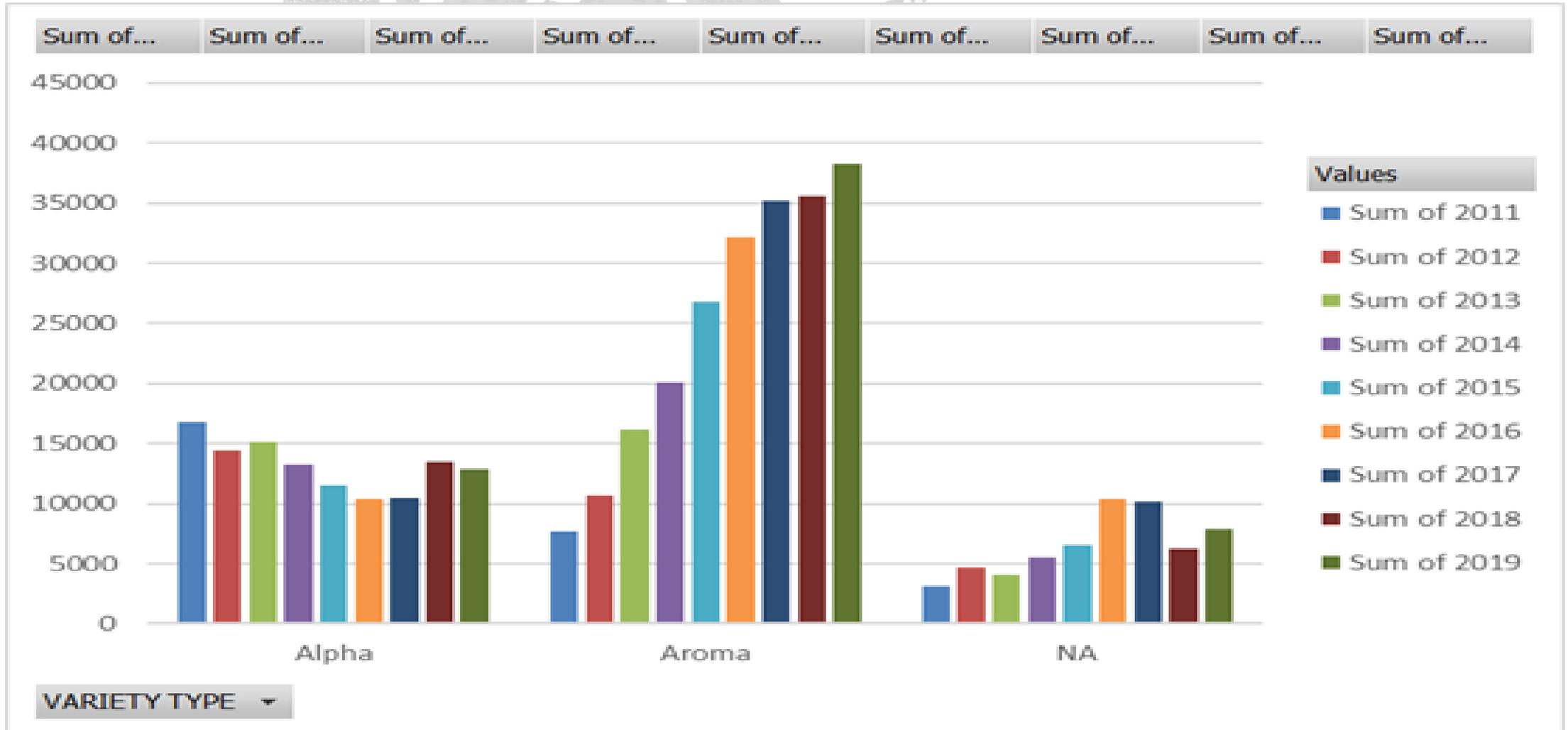
Hop Breeding and the Future of Aroma

Why, how, and the impact of new variety evaluation and selection



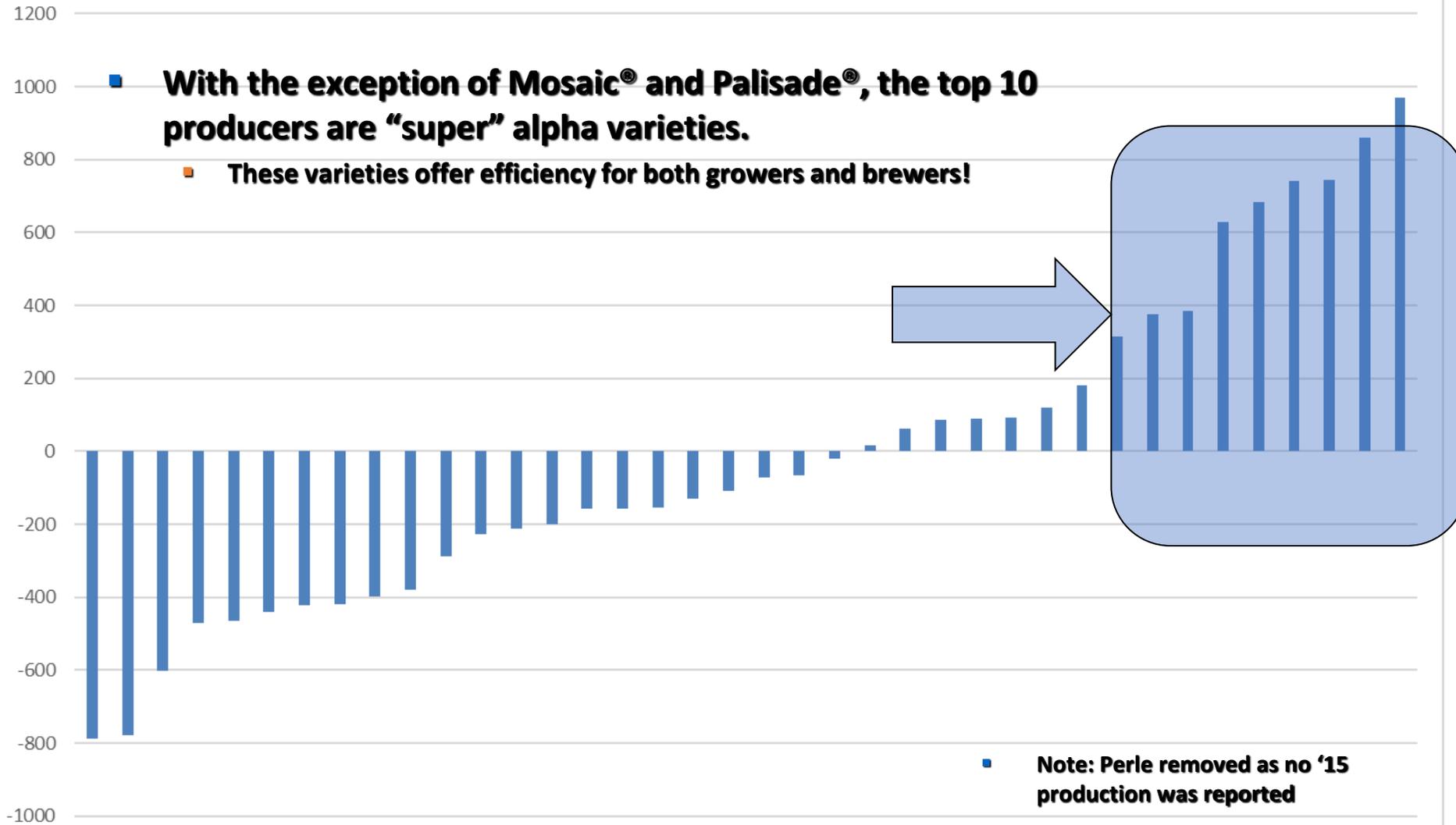
HOP BREEDING COMPANY
YAKIMA CHIEF RANCHES, L.L.C. • JOHN I. HAAS INC.

Acreage Trends: Alpha & Aroma

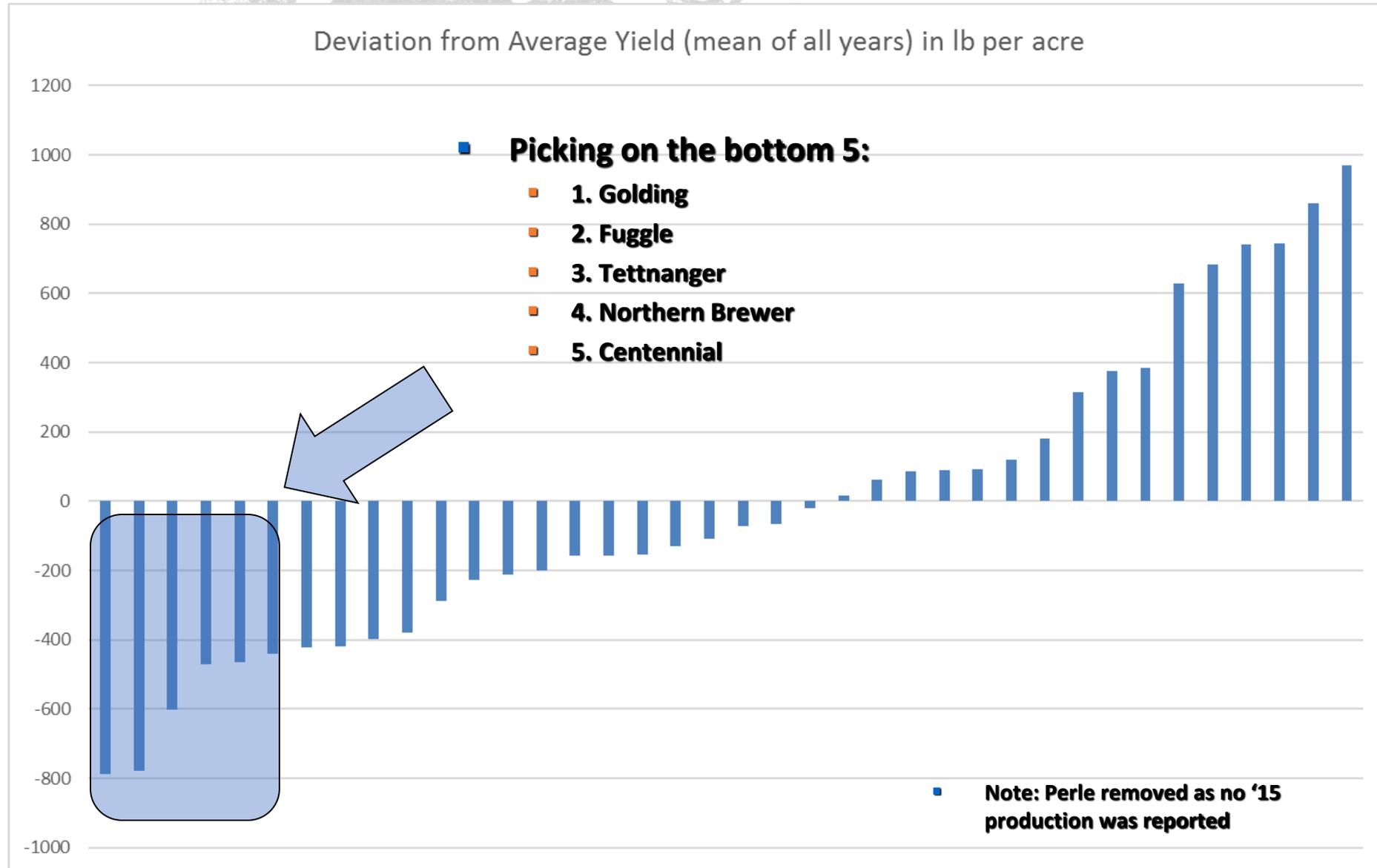


Alpha Hop Efficiency

Deviation from Average Yield (mean of all years) in lb per acre



Average Yields: deviations from the mean



How important is this?

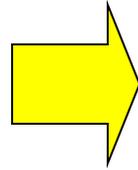
Hop Supply Chain: Each link on the supply chain affects subsequent links.
The efficiency of a hop has a corresponding impact on the chain.

Breeding

Program

New Variety:

- Good yield
- Disease resistant
- Good quality
- Stores well



Farm

Cost/Acre

Yield

COST/UNIT



Handler

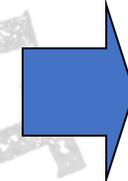
Cost

Storage

Pellet Recoveries

Extract Recoveries

Shipping



Brewery

Efficiency

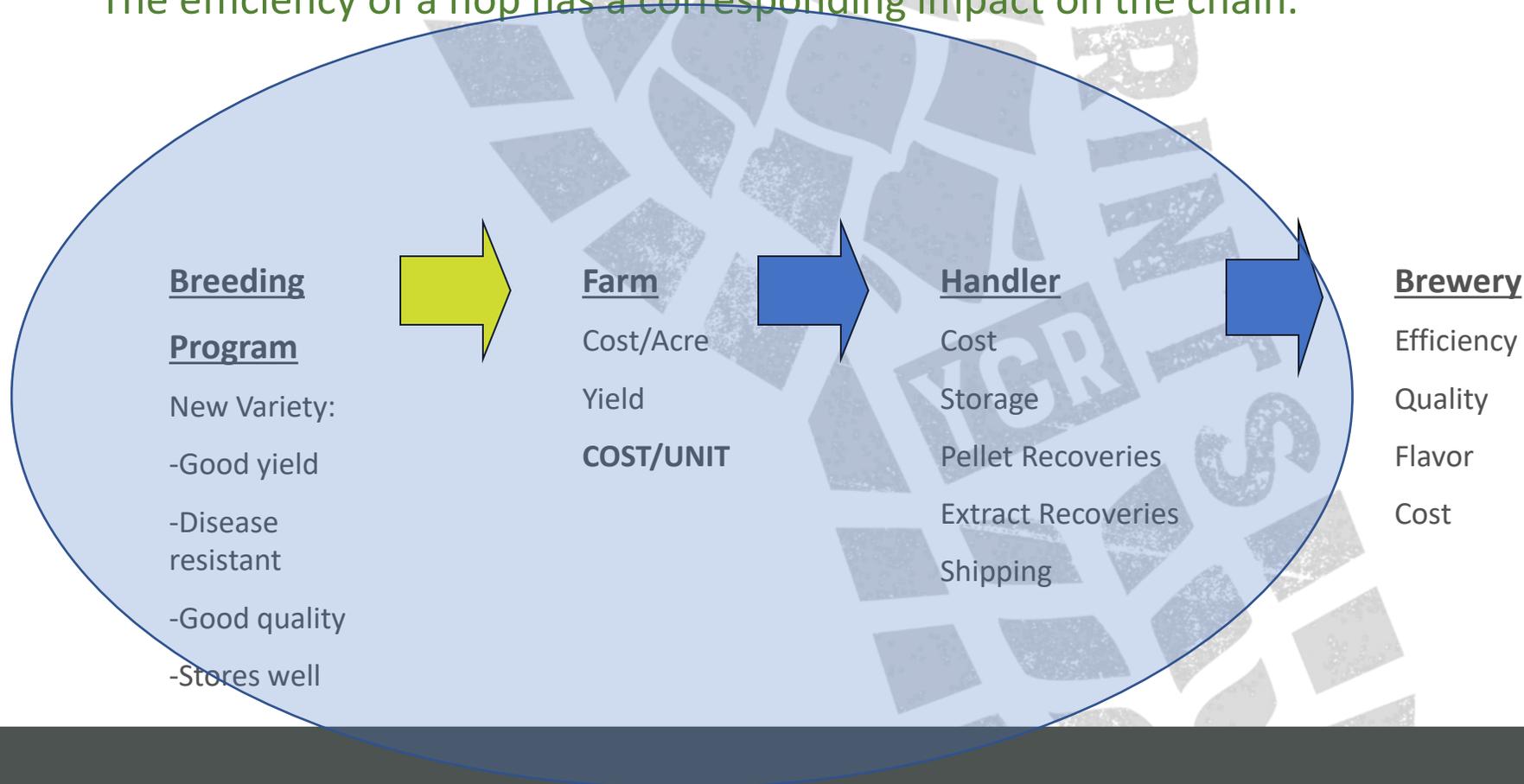
Quality

Flavor

Cost

How important is this?

Hop Supply Chain: Each link on the supply chain affects subsequent links.
The efficiency of a hop has a corresponding impact on the chain.



YCR HOP BREEDING PROGRAM DEVELOPMENT CYCLE

- OVER **11 YEARS** TO BREED & RELEASE A COMMERCIAL HOP BRAND
- SELECTION RATES MAY BY **1 OUT OF 40,000** INITIAL CROSSES
- COSTS OVER **\$1 MILLION** USD TO BRING A NEW BRAND TO MARKET

1

YEAR 1: PARENTAL SELECTION AND CROSSING

- **BASED ON BREEDING OBJECTIVES**

2

YEAR 2: EARLY SELECTION

- **GREENHOUSE SCREENING**
- **HIGH DENSITY FIELD SCREENING**
- **10% SELECTION RATE**

3

YEARS 3,4,5: INTERMEDIATE SELECTION

- **PLANTS TRANSPLANTED TO 18' TRELLIS**
- **1% SELECTION RATE**

YCR HOP BREEDING PROGRAM DEVELOPMENT CYCLE

- OVER **11 YEARS** TO BREED & RELEASE A COMMERCIAL HOP BRAND
- SELECTION RATES MAY BY **1 OUT OF 40,000** INITIAL CROSSES
- COSTS OVER **\$1 MILLION** USD TO GET TO A FINAL BRAND

4

YEAR 6-8: ADVANCED SELECTION

- EXPAND SELECTIONS TO MULTI PLANT PLOTS
- 2% SELECTION RATE

5

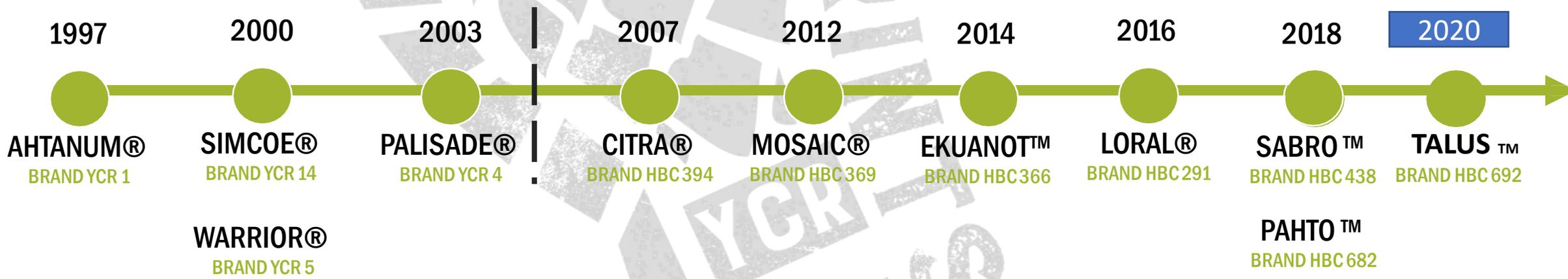
YEAR 9-11: ELITE TRIALS

- SELECTIONS EXPANDED TO COMMERCIAL TRIALS
- SELECTION RATE: <1%

6

YEARS 11+: COMMERCIALIZATION

YCR / HBC HOP VARIETY BRAND LAUNCHES



Yakima Chief Ranches

Footprints® program

WHAT IS FOOTPRINTS®?

- YCR BRAND MANAGEMENT PROGRAM ENSURES:
 1. VERTICALLY INTEGRATED SUPPLY CHAIN
 2. FAIR, SUSTAINABLE RETURNS AND PRICING TO GROWERS AND BREWERS
 3. QUALITY AND FOOD SAFETY GUIDELINES
 4. EMPLOYEE DEVELOPMENT
 5. COMMUNITY STEWARDSHIP



Footprints Internship

- Began in 2013 with 8 growers on 2,235 acres. Last year, YCR worked with ~40 growers on 15,000 acres.
- Varietal Purity Scouting (off-types, male plants, mildews, insects, etc.)
- Soil Sampling & Profiling
- Agronomic Trials & Data Collection
- Raw Hop Sensory Training (Experimental & Commercial)
- 20 former interns are currently employed in the hop and beer industries.

- The 2020 Class:
 - Cooper Allen- Field Crop Management, The Washington State University
 - Shreyas Bindal- Environmental Science, University of Michigan
 - Will Dobson- Plant Breeding & Genetics, University of Florida
 - Zach Fleury- Environmental Science, University of New York
 - Connor Lehman- Entomology, University of Idaho
 - Daniel Luquin- Integrated Plant Sciences, The Washington State University
 - Harrison Moore- Agricultural Economics, The Washington State University
 - Addie Torres- Business Administration & Marketing, Central Washington University

A decade of development...

After 8 - 10 years of evaluation, release is considered.

- Private varieties: PVP begins.

The work is far from over, success is dependent on:

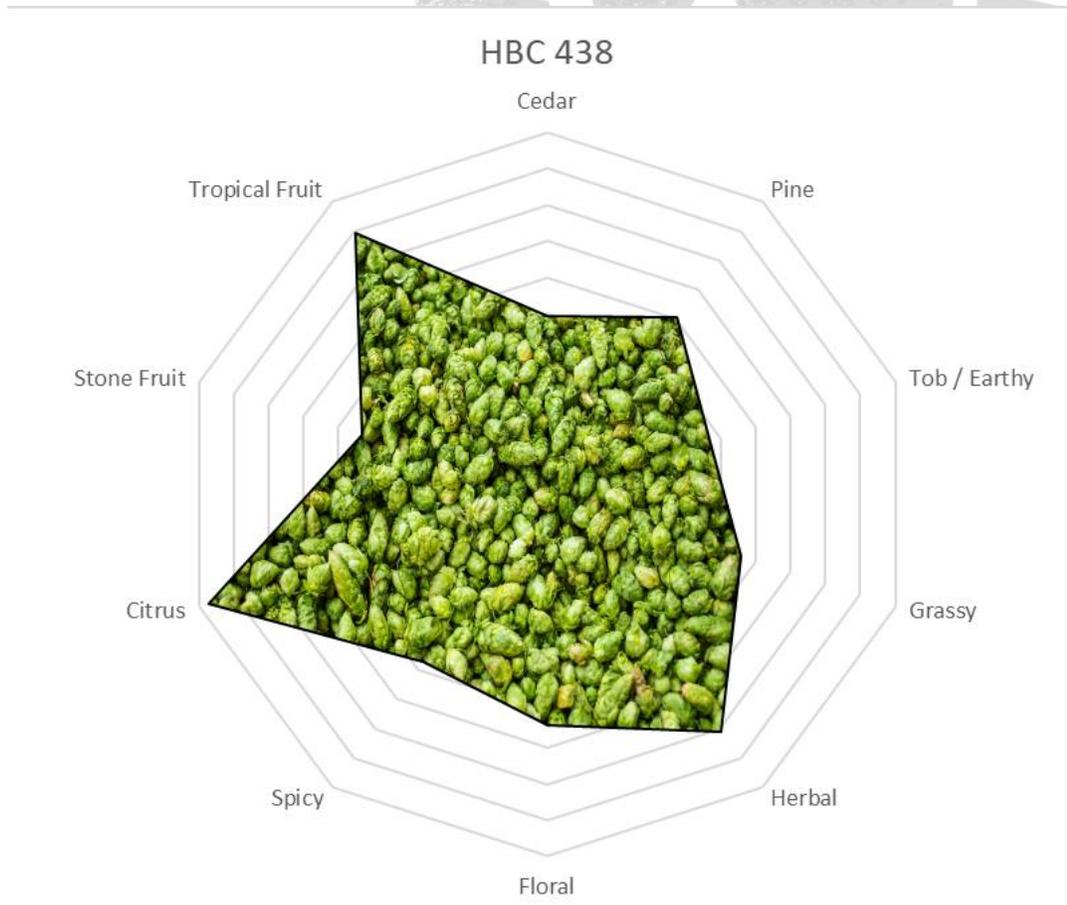
- Continued agronomic success.
- Grower acceptance, usually short term.
- Brewer acceptance, long term.



Understanding aroma...

	438	472	520	630	638	692
TotalOils	3.175	1.575	1.717	2.475	2.850	2.780
A-Pinene	0.115	0.055	0.073	0.075	0.068	0.094
B-Pinene	0.915	0.505	0.513	0.670	0.485	0.854
Myrcene	62.723	36.728	40.245	43.788	37.428	52.578
2-methyl-butyl isobutyrate	1.955	2.623	0.580	1.543	1.273	1.684
Limonene	0.280	0.155	0.192	0.178	0.148	0.224
Linalool	0.443	0.193	0.200	0.253	0.295	0.674
Isobutyric Acid	0.010	0.005	0.005	0.010	0.020	0.000
Caryophyllene	10.398	28.800	22.730	13.138	10.993	7.130
Farnesene	0.678	5.163	0.140	0.078	0.200	0.170
Humulene	8.743	0.848	17.512	17.698	17.148	17.726
Citral	0.978	3.345	1.837	1.920	1.520	0.390
Geranyl Acetate 1	0.065	0.105	0.110	0.273	0.183	0.088
Geranyl Acetate 2	0.060	0.010	0.030	0.260	0.020	0.045
Citronellol	0.913	0.403	1.455	1.143	3.548	1.184
Nerol	0.130	0.153	0.200	0.135	0.398	0.334
Geraniol	0.905	0.245	0.032	0.088	0.170	1.664
B-Ionene	0.008	0.030	0.013	0.015	0.013	0.008
Carophyllene Oxide	0.025	0.160	0.085	0.040	0.050	0.080

HBC 438: SABRO™ neomexicanus cross



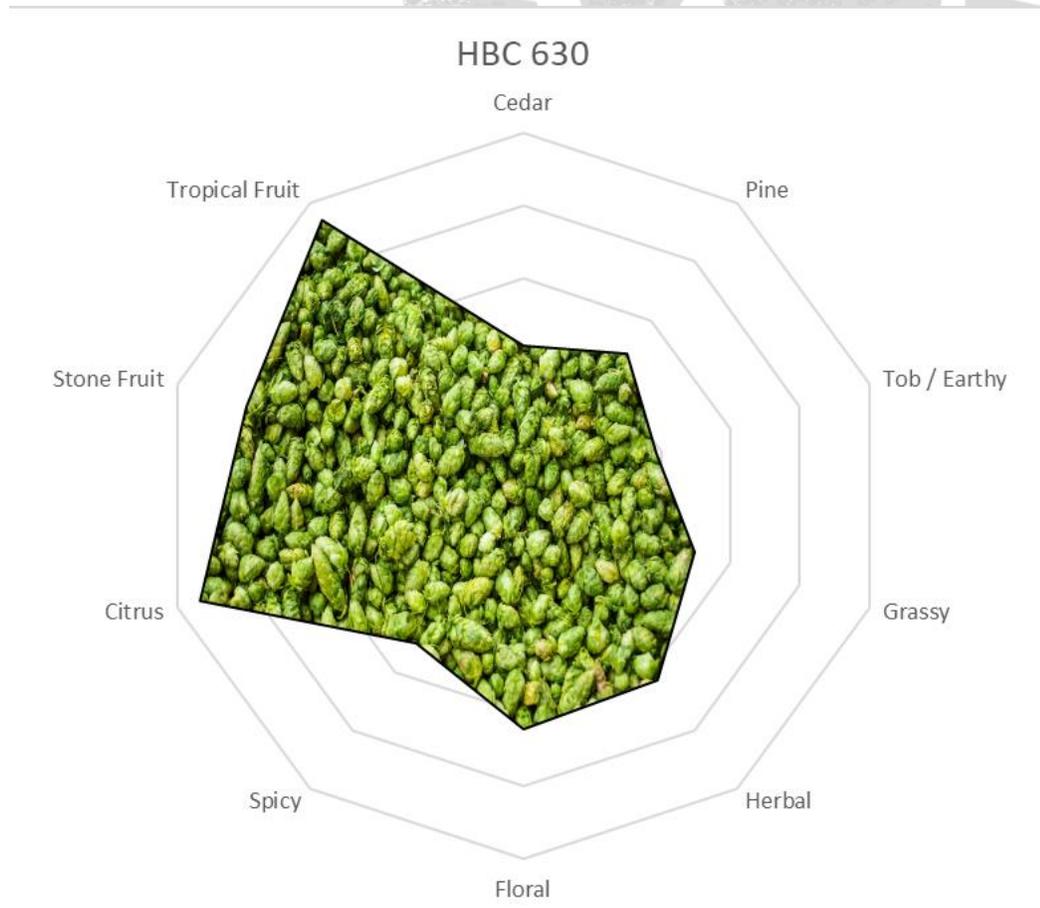
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Caryophyllene	10.398
Farnesene	0.678
Humulene	8.743
Citral	0.978
Geranyl Acetate 1	0.065
Geranyl Acetate 2	0.060
Citronellol	0.913
Nerol	0.130
Geraniol	0.905
B-Ionene	0.008
Carophyllene Oxide	0.025

HBC 472: sister of 438, woody



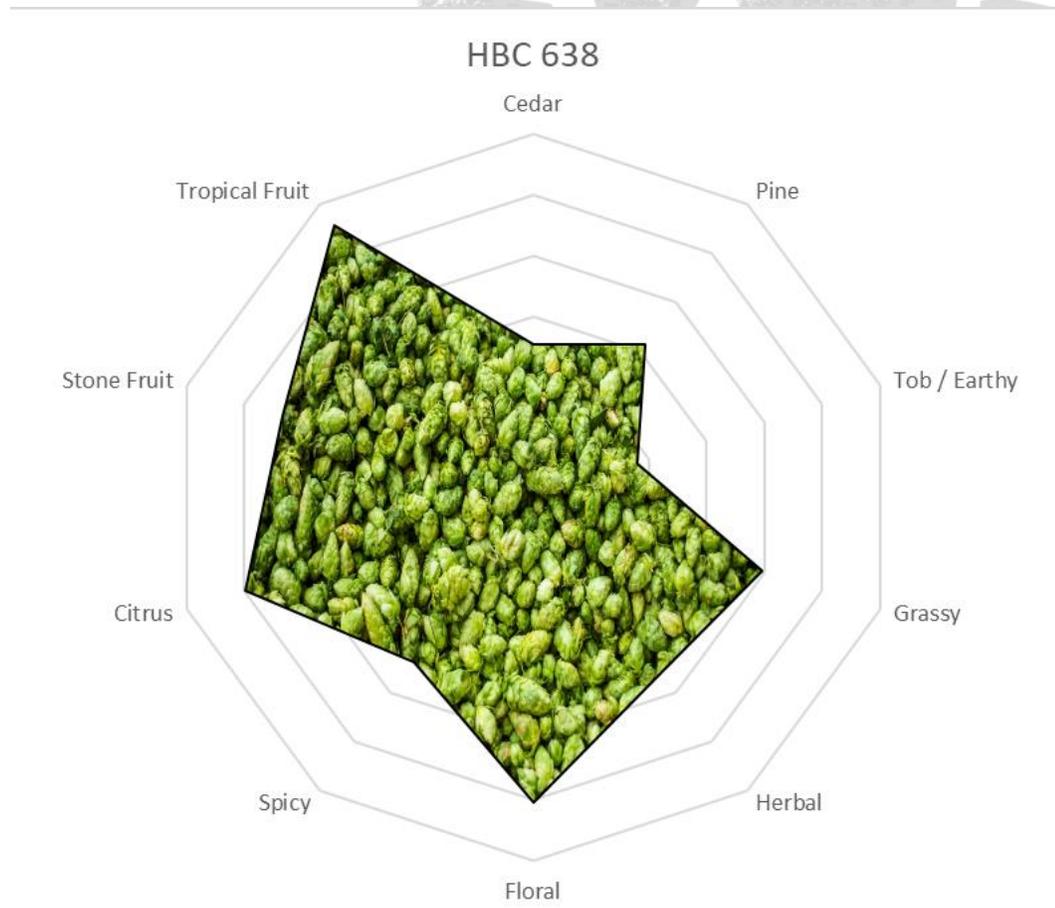
	472
TotalOils	1.575
A-Pinene	0.055
B-Pinene	0.505
Myrcene	36.728
2-methyl-butyl isobutyrate	2.623
Limonene	0.155
Linalool	0.193
Isobutyric Acid	0.005
Caryophyllene	28.800
Farnesene	5.163
Humulene	0.848
Citral	3.345
Geranyl Acetate 1	0.105
Geranyl Acetate 2	0.010
Citronellol	0.403
Nerol	0.153
Geraniol	0.245
B-Ionene	0.030
Carophyllene Oxide	0.160

HBC 630: very fruity, cherry candy



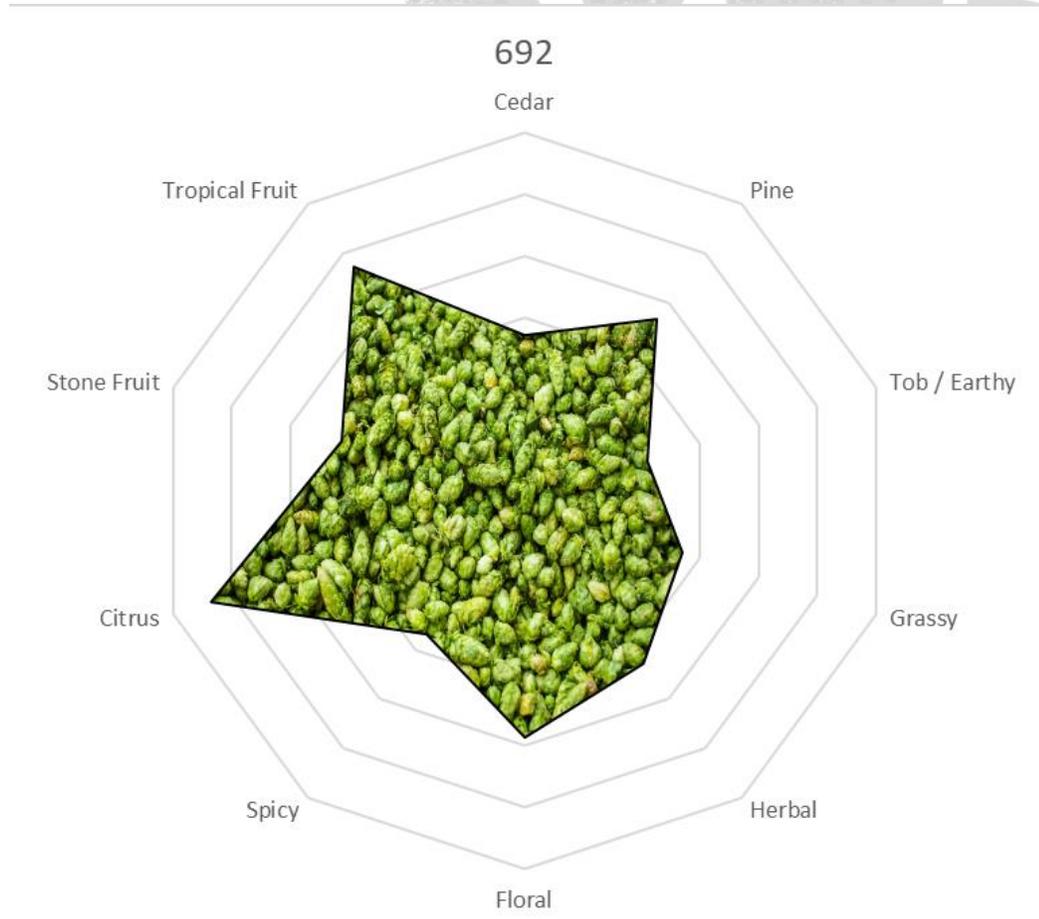
	630
TotalOils	2.475
A-Pinene	0.075
B-Pinene	0.670
Myrcene	43.788
2-methyl-butyl isobutyrate	1.543
Limonene	0.178
Linalool	0.253
Isobutyric Acid	0.010
Caryophyllene	13.138
Farnesene	0.078
Humulene	17.698
Citral	1.920
Geranyl Acetate 1	0.273
Geranyl Acetate 2	0.260
Citronellol	1.143
Nerol	0.135
Geraniol	0.088
B-Ionene	0.015
Carophyllene Oxide	0.040

HBC 638: tropical, citrus, limes



	638
TotalOils	2.850
A-Pinene	0.068
B-Pinene	0.485
Myrcene	37.428
2-methyl-butyl isobutyrate	1.273
Limonene	0.148
Linalool	0.295
Isobutyric Acid	0.020
Caryophyllene	10.993
Farnesene	0.200
Humulene	17.148
Citral	1.520
Geranyl Acetate 1	0.183
Geranyl Acetate 2	0.020
Citronellol	3.548
Nerol	0.398
Geraniol	0.170
B-Ionene	0.013
Carophyllene Oxide	0.050

HBC 692: big impact, grapefruit, peach, herbal



	692
TotalOils	2.780
A-Pinene	0.094
B-Pinene	0.854
Myrcene	52.578
2-methyl-butyl isobutyrate	1.684
Limonene	0.224
Linalool	0.674
Isobutyric Acid	0.000
Caryophyllene	7.130
Farnesene	0.170
Humulene	17.726
Citral	0.390
Geranyl Acetate 1	0.088
Geranyl Acetate 2	0.045
Citronellol	1.184
Nerol	0.334
Geraniol	1.664
B-Ionene	0.008
Carophyllene Oxide	0.080

Impact of Breeding: Top Varieties

Of the top 10

- 5 released since '00
 - 50% of top 10
- 4 of those YCR/HBC
 - 40% of top 10
- CITRA is new #1

Top 10 PNW Hop Varieties by Acreage:

Rank	2013	2014	2015	2016	2017	2018
1	Cascade	Cascade	Cascade	Cascade	Cascade	Citra®, HBC 394
2	Zeus	Zeus	Centennial	Centennial	Centennial	Cascade
3	Summit	Centennial	Zeus	Citra®, HBC 394	Citra®, HBC 394	Centennial
4	Columbus/Tomahawk	Summit	Simcoe®, YCR 14	Simcoe®, YCR 14	Simcoe®, YCR 14	Zeus
5	Centennial	Simcoe®, YCR 14	Citra®, HBC 394	Zeus	Zeus	Simcoe®, YCR 14
6	Nugget	Citra®, HBC 394	Mosaic®, HBC 369	Mosaic®, HBC 369	Mosaic®, HBC 369	Chinook
7	Chinook	Columbus/Tomahawk	Chinook	Chinook	Chinook	Mosaic®, HBC 369
8	Citra®, HBC 394	Chinook	Columbus/Tomahawk	Summit	Willamette	Columbus/Tomahawk
9	Simcoe®, YCR 14	Nugget	Summit	Willamette	Summit	Amarillo®, VGXP01
10	Super Galena™	Willamette	Willamette	Columbus/Tomahawk	Columbus/Tomahawk	Pahto®, HBC 682

Please Reach Out With Any Questions



THANK YOU!

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