Growing Hops in California

University of California
Agriculture and Natural Resources

photo credits: sfbrewersguild.org

What is a hop?

Hop history

Growing hops

Harvesting hops

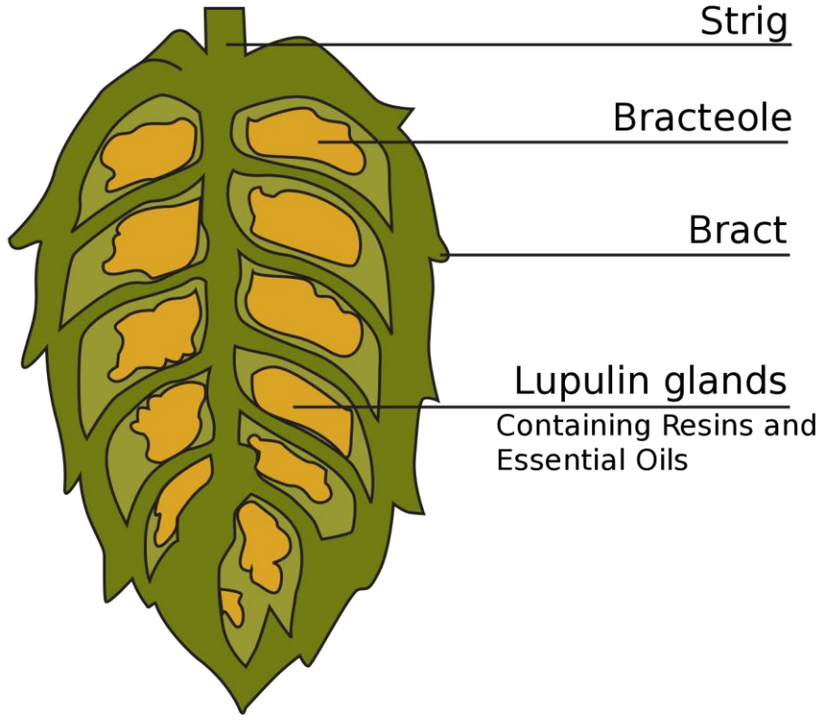
Market consideration

University of California
Agriculture and Natural Resources

Hops

Humulus lupulus
Family: *Cannabaceae*

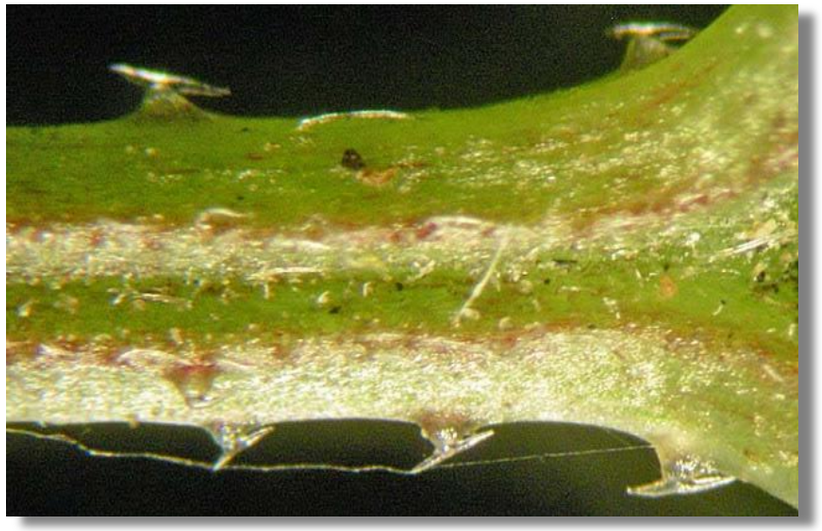
- **Perennial**
- **Climbing plant**
- **Lifespan of up to 20 years**
- **Flowers harvested for brewing beer**
- **Aggressive growers (‘wolf plant’)**
- **Respond to seasonal changes in light**



photocredits: Wikipedia, Rogue Ales,

First shoots in spring emerge from crown

Bines climb

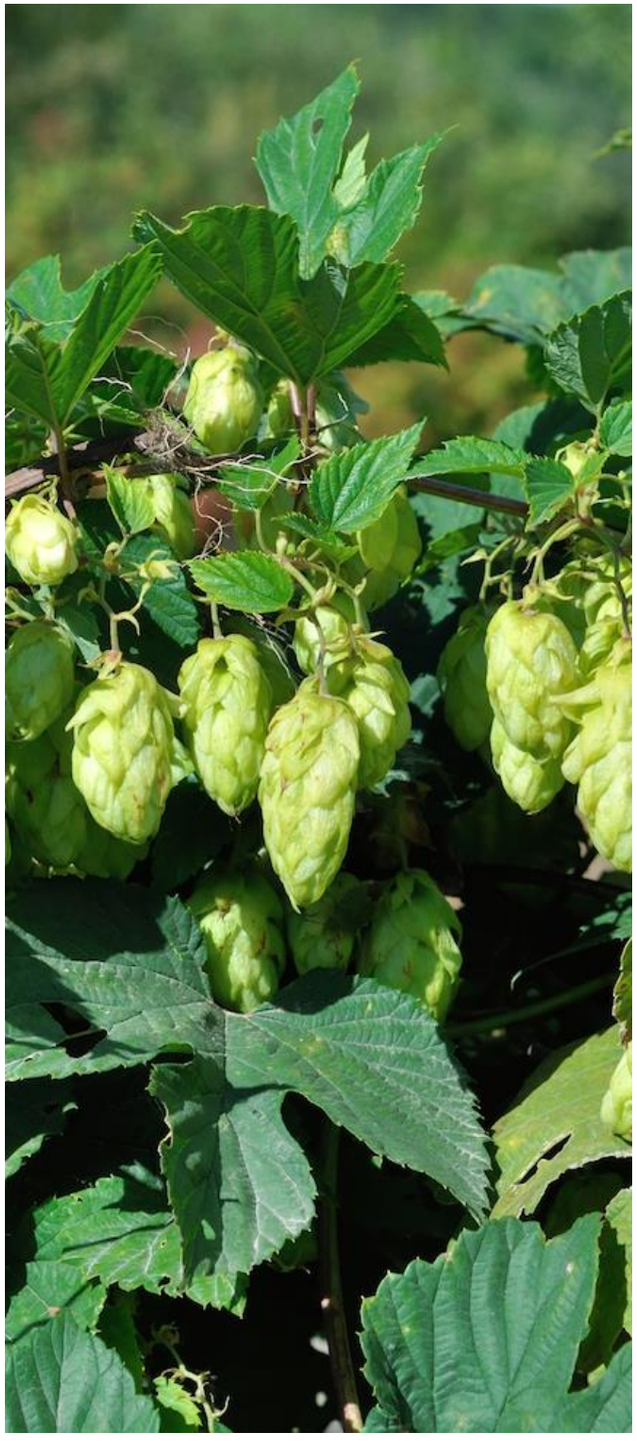


Hop bine (not a vine)

Young hop flowers

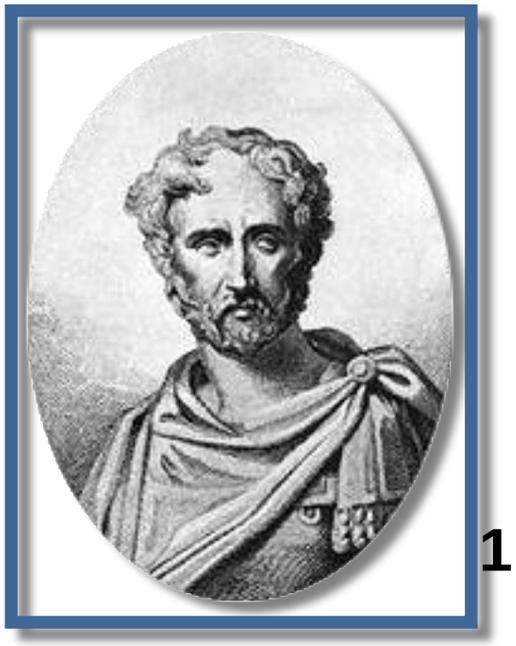
University of California
Agriculture and Natural Resources

photo credits: commons.wikimedia.org, NC Small Fruit and Veg IPM, beyondthehumaneye.blogspot.com

University of California
Agriculture and Natural Resources

photocredits: NC Small Fruit and Veg IPM,StarkBros, [hopflavourblog.com](), [agroliquid.com]()



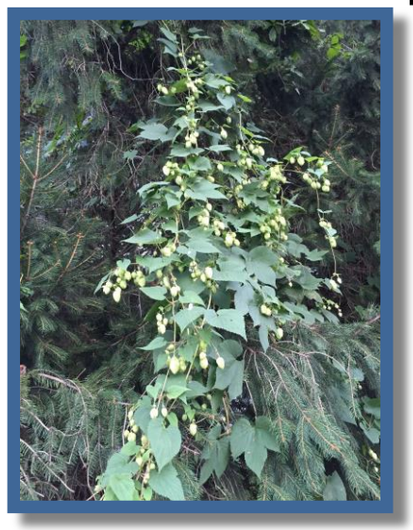
History

77 AD: Pliny the Elder writes *Naturalis Historia*

822 AD: Hops first mentioned in brewing context
Abbot Adalhard of Picardy

1150 AD: Germany begins integrating hops into beers

England begrudges hops until well into the 17th century



“*A wicked and pernicious weed…*”
-Henry VIII

‘The worst thing about invading Picardy is that we’ve drunk all our ale and now must settle for this awful hopped local drivel for the next 10 days.’

-Artistic interpretation of Henry VIII’s dissatisfied commander on campaign in Picardy.

photocredits: Wikipedia, zythophile.co.uk, aleteia.org

FIGURE 1.—The principal hop-producing districts of the United States and acres harvested by States in 1959.

1959: California is home to 5,800 acres of hops (18% of Western US Production)

Current State of the Industry: millennials ruin everything

?

"Hop Kiln Winery is AMAZING!!!"

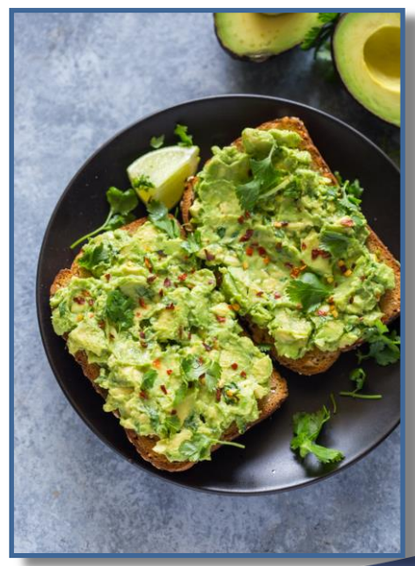
Review of HKG Estate Wines - CLOSED

HKG Estate Wines

6050 Westside Rd, Healdsburg, CA 95448-8318

+1 707-433-6491 Website E-mail Imp

23 photos



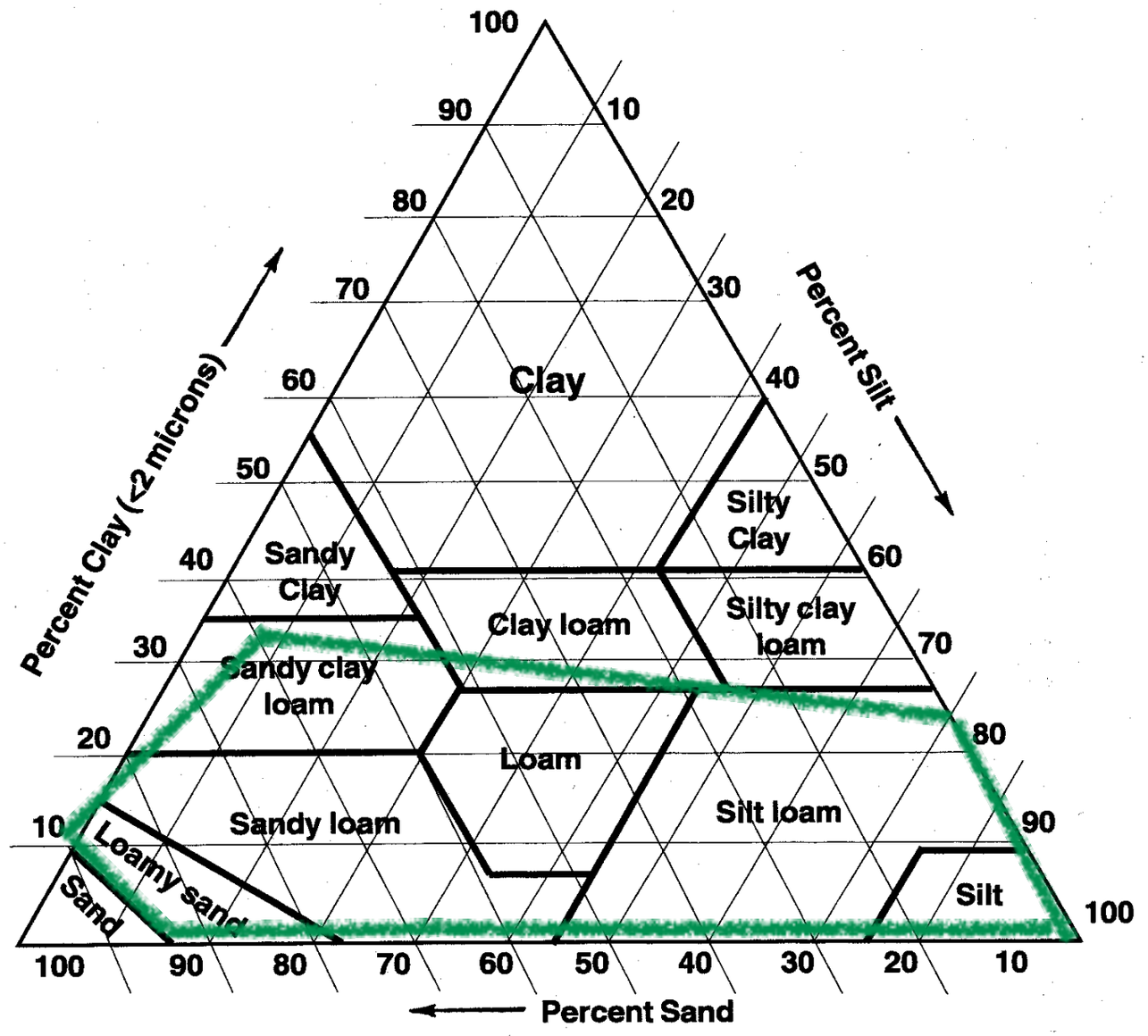
Can we grow hops in California?

Silly question, but why?

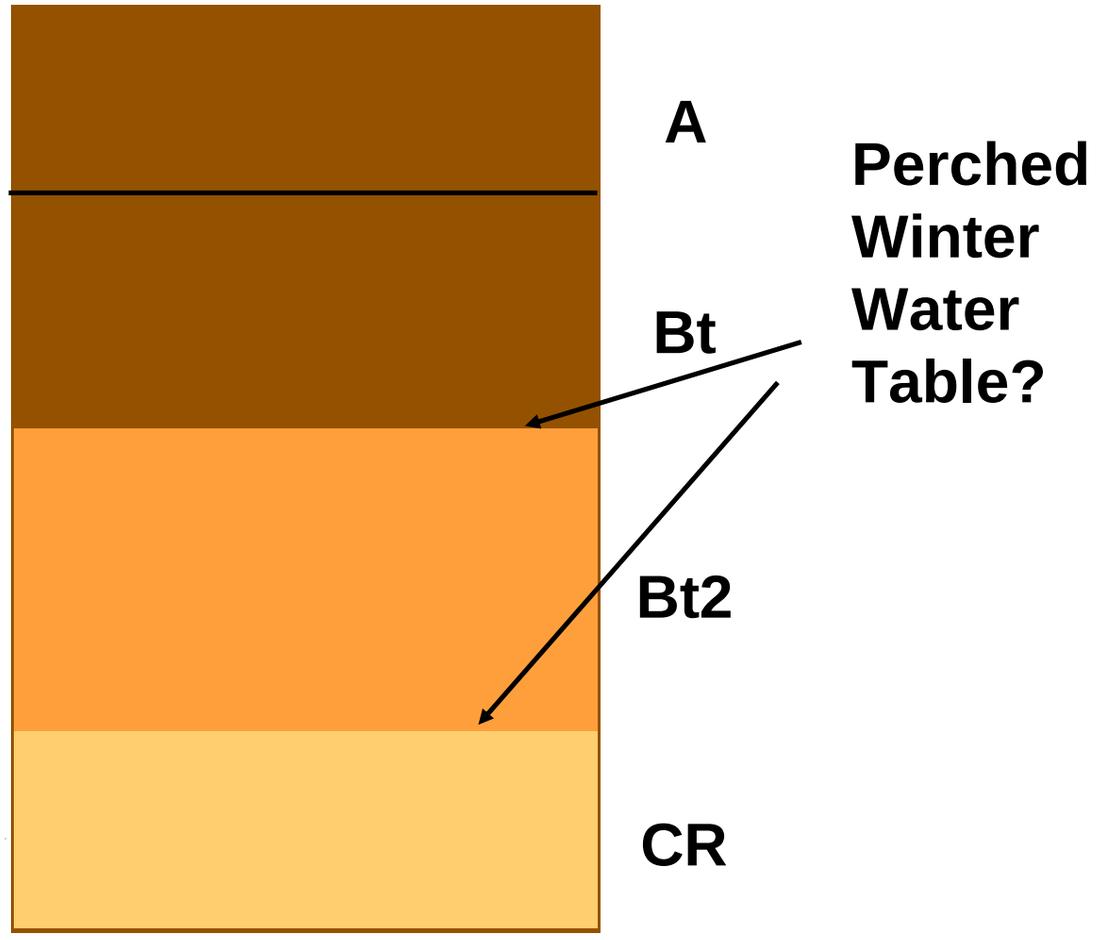
Less than 1,000 acres of hop production in California

Soil

Ideal pH 6.0-6.5
hops are somewhat forgiving



Drainage: in top soil as well as sub soil
(Hop roots will grow 15’ deep)



UC Soil Web

< Close

SoilWeb

UCDAVIS NRCS

Vina

Soil Data Explorer | Series Extent Explorer | Description

▲ Soil Profiles

Typical Profile >

Org. Matter | Clay

Sand | K_{sat}

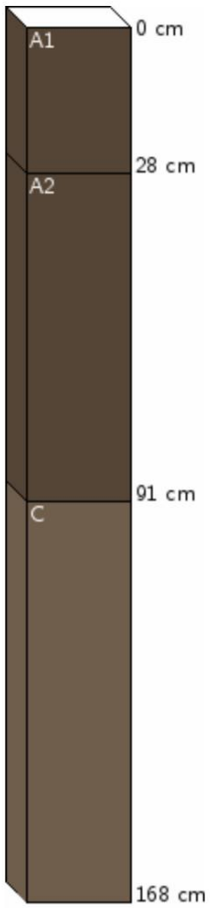
pH | K_f Factor

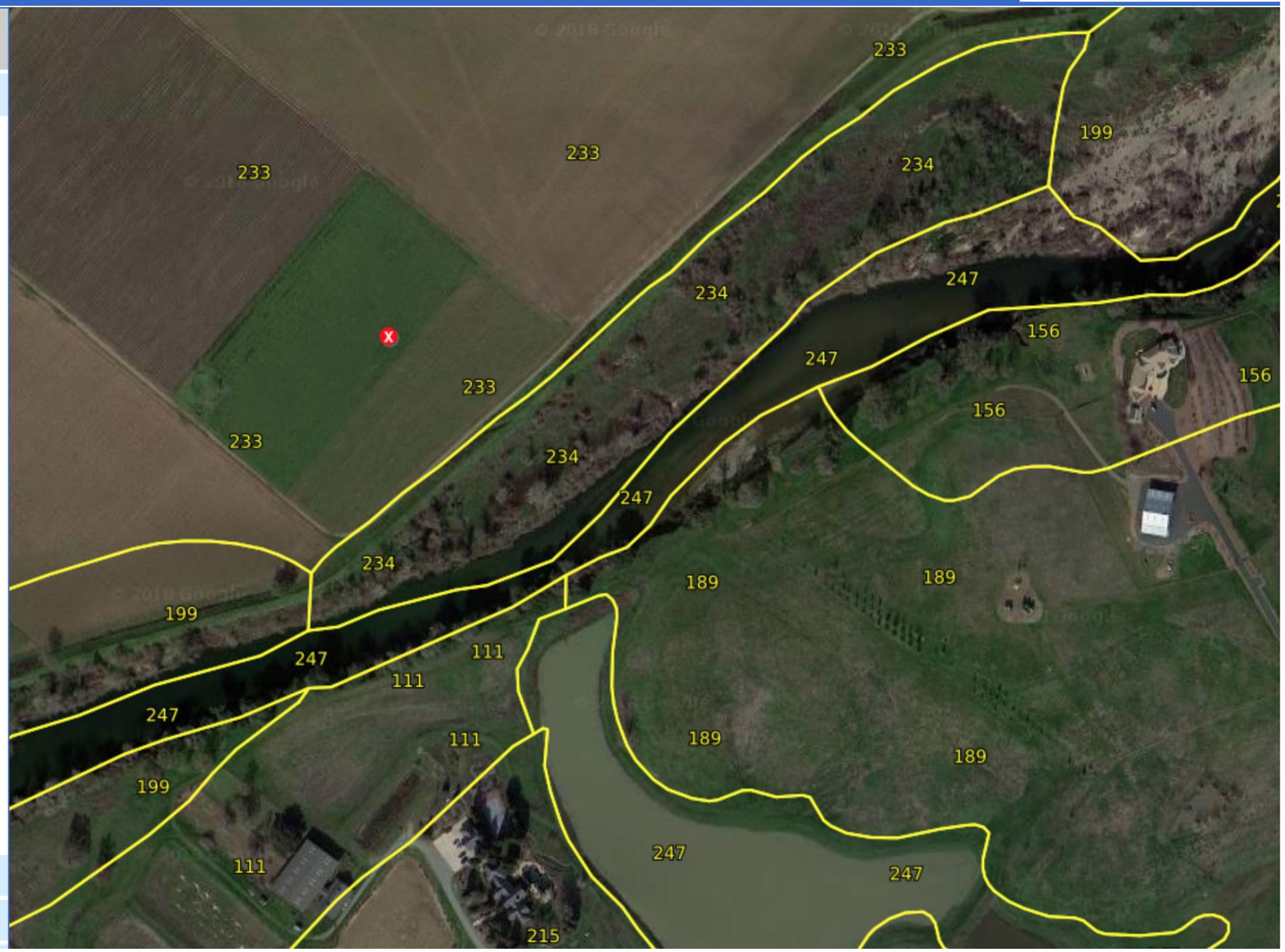
EC | SAR

$CaCO_3$ | Gypsum

CEC @ pH7

Linear Ext.





▼ Soil Taxonomy

▼ Land Classification

University of California
Agriculture and Natural Resources

Establishment

Some thoughts to immediately discard:

- “Poles are expensive so let’s really space them out”
- “I don’t need such long poles if I don’t put ‘em 3 feet in the ground”
- “This thinner wire should work . . .”
- “the rows have to be really wide ‘cause I got a big tractor”
- “let’s grow 10 varieties in 4 rows”
- “we won’t need irrigation”
- “fertilizer is just too expensive.”
- “healthy hop plants don’t get bugs or disease.”
- “I’m gonna plant the hops first and then put in the trellis and irrigation . . .”

- Great Lakes Hops

University of California
Agriculture and Natural Resources

photo credits: Smithrock Hop Farm

Establishment

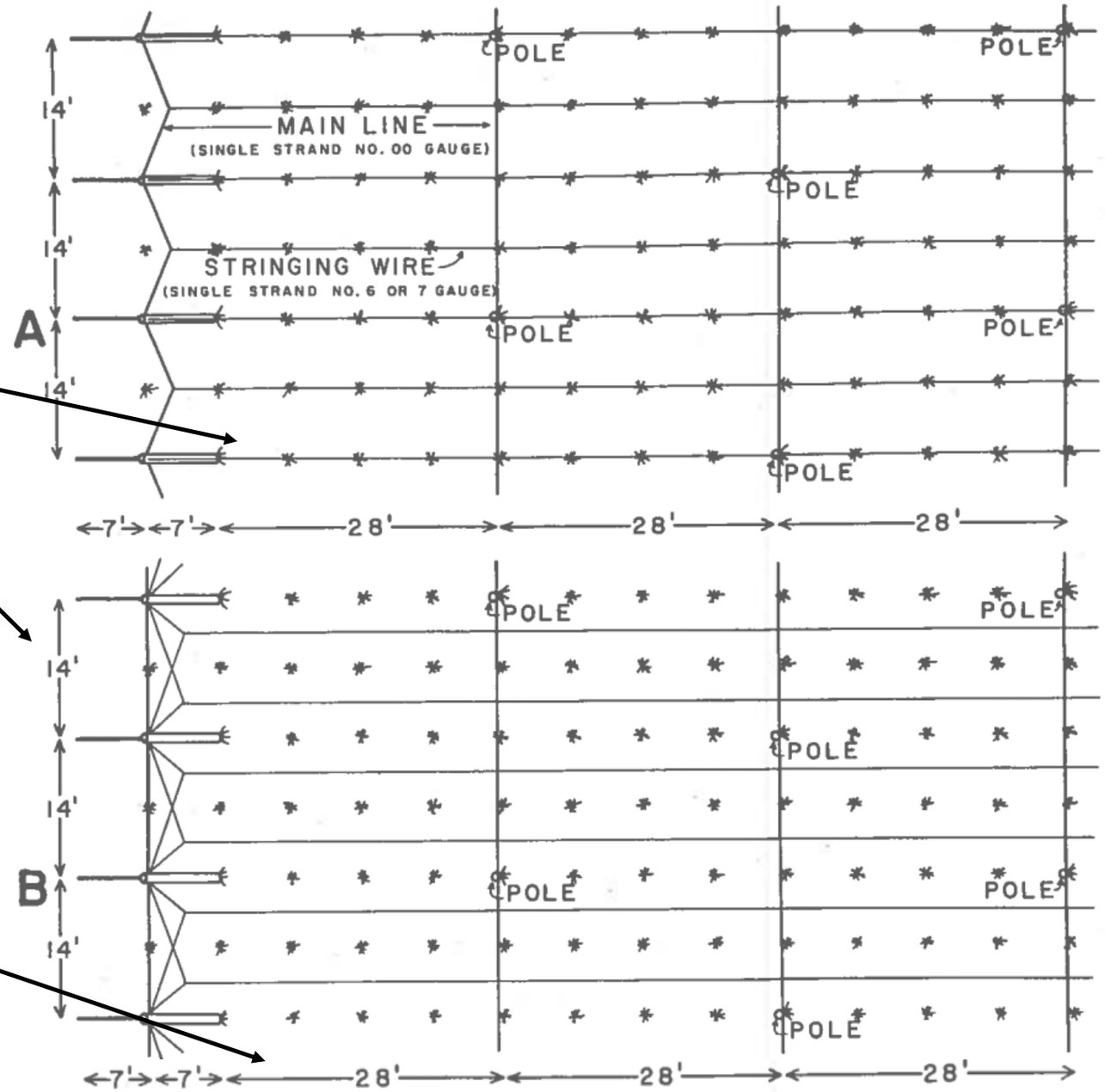
Spacing Considerations

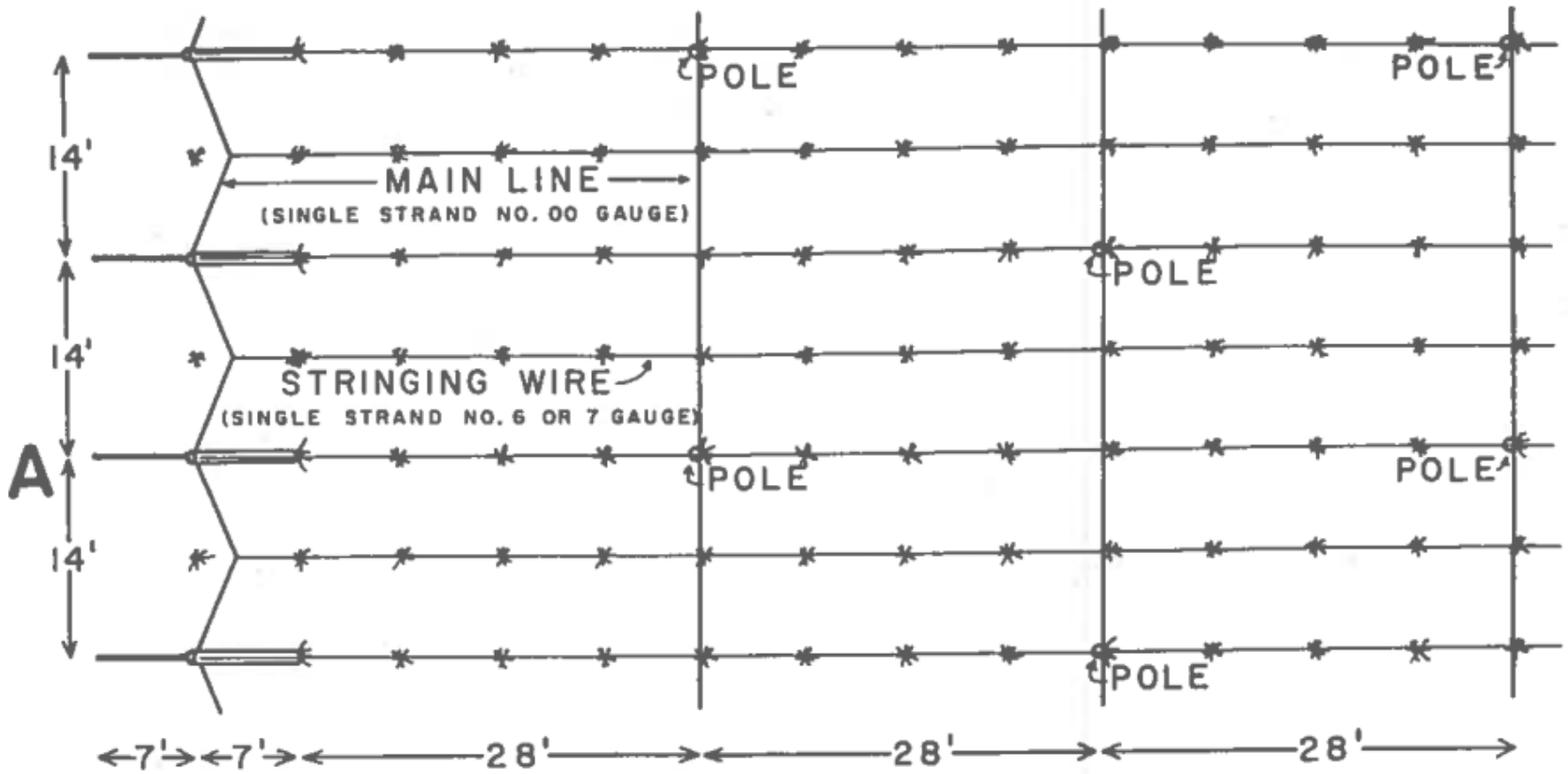
Variety-Dependent

Side arm length? (tangled bines)
36-48”

Character (shady, short, vigorous?)
12’ - British and Continental hops
14’ - American

Mass





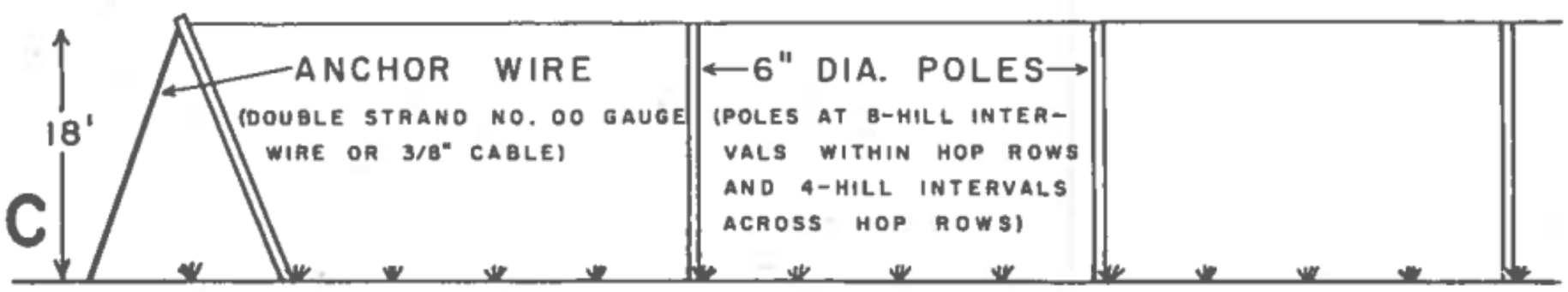
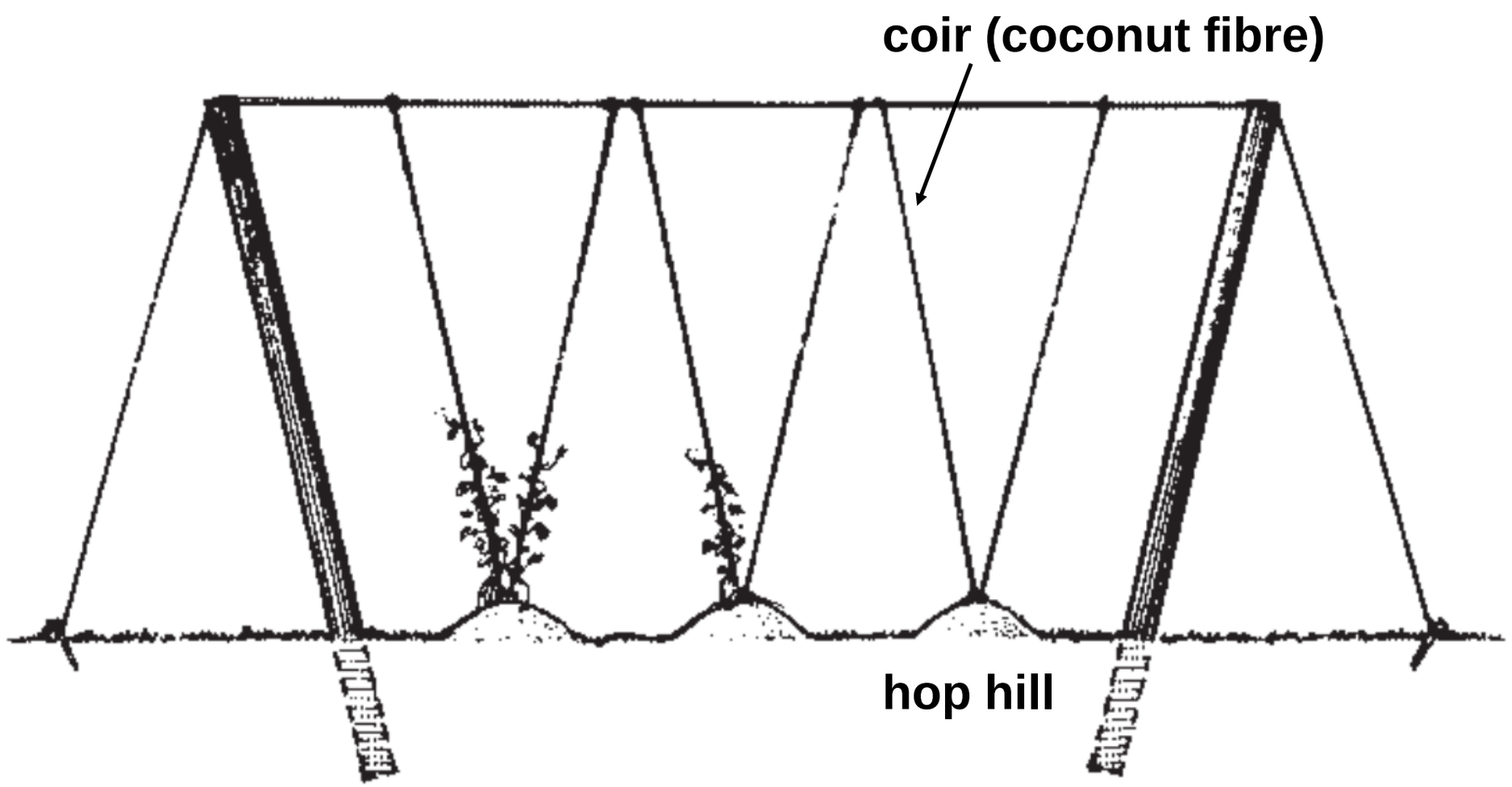


photo credits: USDA Hop Production Manual, 1961



<- row direction ->

Hop yard Construction Resources

https://www.canr.msu.edu/hops/getting_started

Hopyard Design	https://www.greatlakeshops.com/hops-blog/selecting-the-right-trellis-design-to-grow-great-hops
Hopyard Construction University of Vermont:	http://www.uvm.edu/extension/cropsoil/wp-content/uploads/Rainville-Building-a-Hopyard.pdf

Planting and Training

Rhizomes
(late winter) 3 per hill

Live Plants
(Early Spring: frost free)

Do NOT prune in the 1st year; prune first flush of shoots in subsequent springs
On second flush, select 2-3 strong bines per line. Train them, prune the rest back.

University of California
Agriculture and Natural Resources

photo credits: buyhoprhizomes.com, Home Brew Talk, MSU

Water

Drip irrigation: Long sets, soil pits, use moisture sensors

Think: root rot and verticillium (hops are susceptible)

Monitor for rodent damage: trapping programs, monitoring programs

Maintenance: pH, minerals, acidification, algae

Do not sprinkle irrigate

Roughly 23” of evapotranspiration annually

Fertility

Pre Plant

Soil test

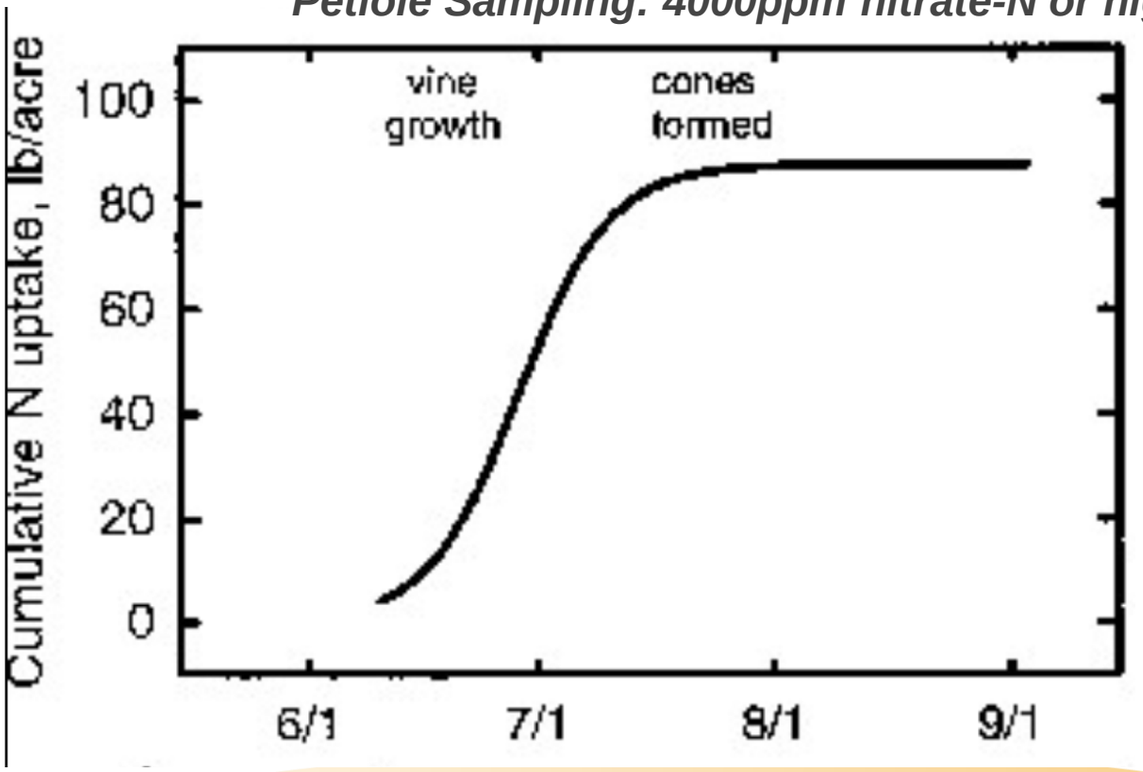
Amendments (Gyp, Sulfur)

In Season

Ravenous nitrogen use: Maximum 4 lb N/ acre/ d

75-150 lbs total N through Mid-July

Petiole Sampling: 4000ppm nitrate-N or higher, did not respond significantly to additional N



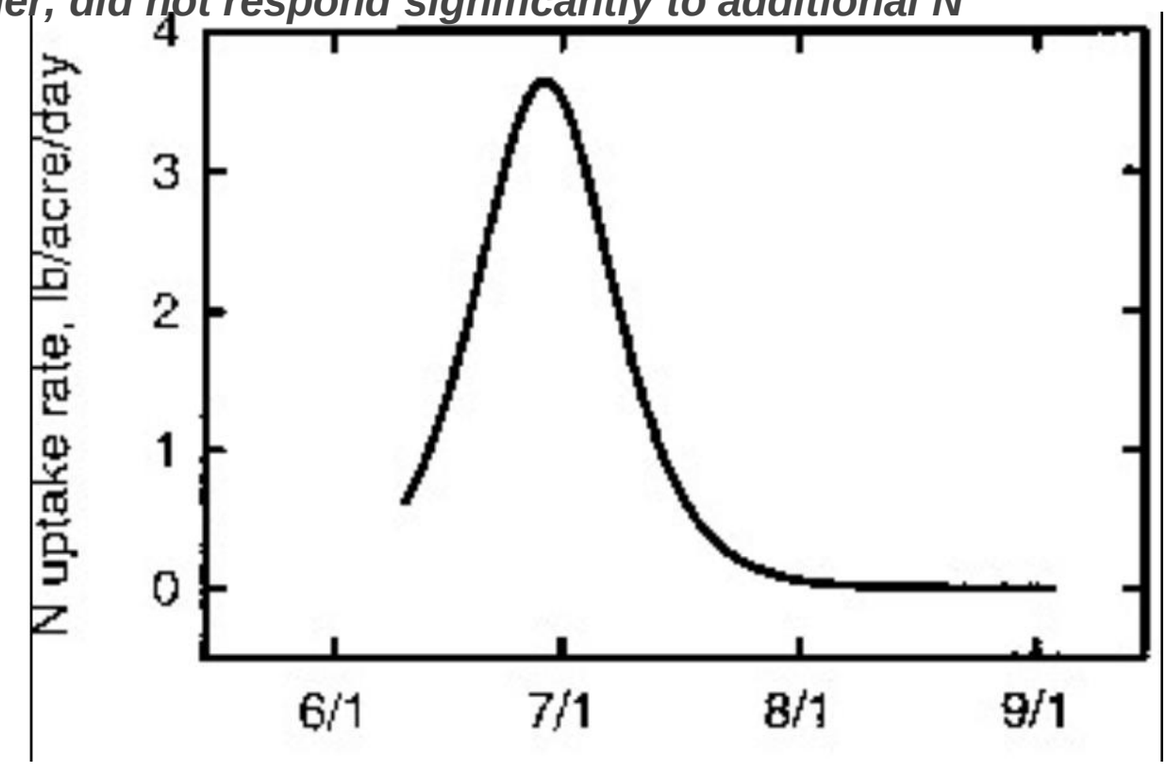


photo credits: Michigan State University Cooperative Extension

Spider Mites
Tetranychus urticae

Stippling damage

- **Reduce plant stress**
- **Treat when mites are active (warm, dry)**
- **Prune lower canopy and bines**
- **Weekly monitoring April/May-harvest**
- **Avoid broad-spectrum pesticides**

Severe Spider Mite Damage

University of California
Agriculture and Natural Resources

photo credits: pnwhandbooks.org, Turner et al. (2011) Agronomy Journal

Aphids
Phorodon humuli

Sooty mold on cones

- **Overwinter in *prunus* species**
- **Favor *excessive* N (new shoot growth)**
- **Treat early in season (and particularly when cones form)**
- **Monitor after 58-60 ºF until harvest**
- **Encourage predatory mites**

photo credits: UVM, bugguide.net,

Powdery Mildew

- **Historic Legacy in California**
- **Varietal Resistance*: Mt. Hood, Newport, Nugget, Triple Pearl, Comet**
- **Early-season varieties**
- **Multiple mode of action fungicides**
- **Sanitation: remove overwintering opportunities**
- **Scout for and prune infected shoots earl in season**

Varieties

Strong Varieties in San Diego

Cascade
Columbus
Chinook
Crystal

Decent Varieties in San Diego

Glacier
Mt.Hood
Nugget
Neo 1 (neomexicanus)
Sterling

Failures

Saaz and other nobles - Fried
Willamette - Died
Magnum – Low yield. Not many flowers

https://www.ars.usda.gov/pacific-west-area/corvallis-or/forage-seed-and-cereal-research/people/john-henning/cultindex/

University of California
Agriculture and Natural Resources

photo credits: Menu in Progress

Yields (lbs/acre*)

•	Cascade	1,600-2,000
•	Centennial	1,500-1,750
•	Fuggle H	1,070-1,600
•	Glacier	2,400-2,600
•	Nugget	1,800-2,200
•	Zeus (CTZ)	2,500-2,900

Data from USA Hops, Hop Growers of American, variety manual 2011, 2013, 2014

*Average data, mostly from Oregon, Idaho, Washington. https://www.usahops.org/enthusiasts/stats.html

Local Varieties for your reference (impressions from a hop grower in Chico)

1. **Chinook**-I really like and is vigorous but mites love them. I am told that they produce some different compounds that the mites hone in on. I always see mites earlier and in greater populations in Chinooks.

2. I like Late **Clusters** and they are historically accurate for our area. Some brewers like them, some not so much. You can (Steve Dressler did before he retired) make a bitch'n IPA with them. Tastes/smells different than a typical IPA of course.

3. **Triple Pearl**-I am only in year two of these, but I like them and the brewers seem to like them as well. O74 I think is the best.

4. **Yakima Gold** and **Tahoma** might show some promise and popularity.

5. Growers and brewers seem to like the **Cashmere**.

6. **Crystal** have been doing great in our yard for a few years now. Vigorous and the brewers like them.

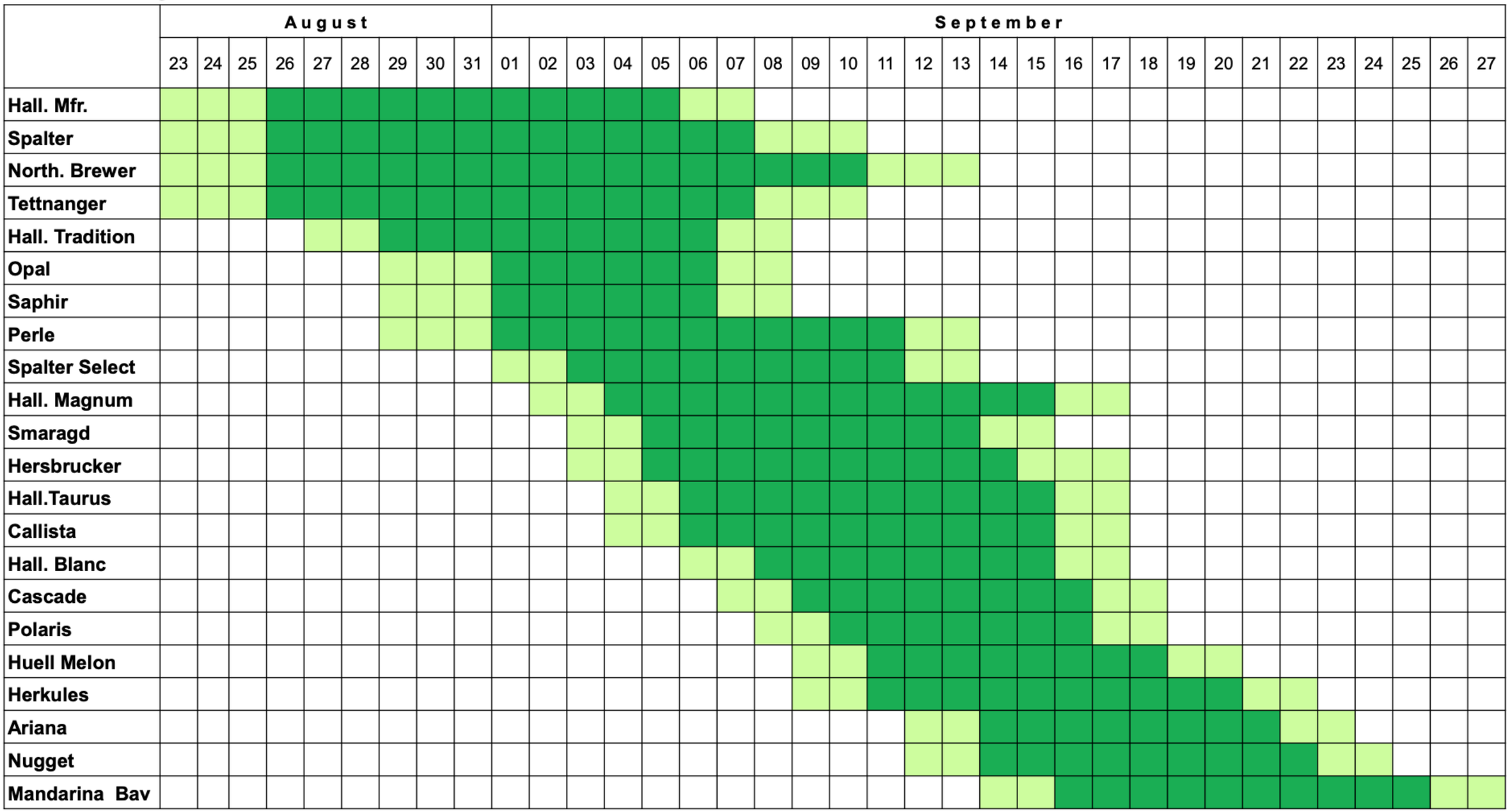
7. Everybody loves **Cascades**. If they grow in that area, do it. Mine have been slowing down in vigor (not growing as high on the trellis) but still load up nice with cones. Tough one to manage growth on as they produce a lot of shoots. Typically come on early and need to be pruned back.

8. **Centennial** are great but tricky to grow, even for seasoned veterans of the hop business.

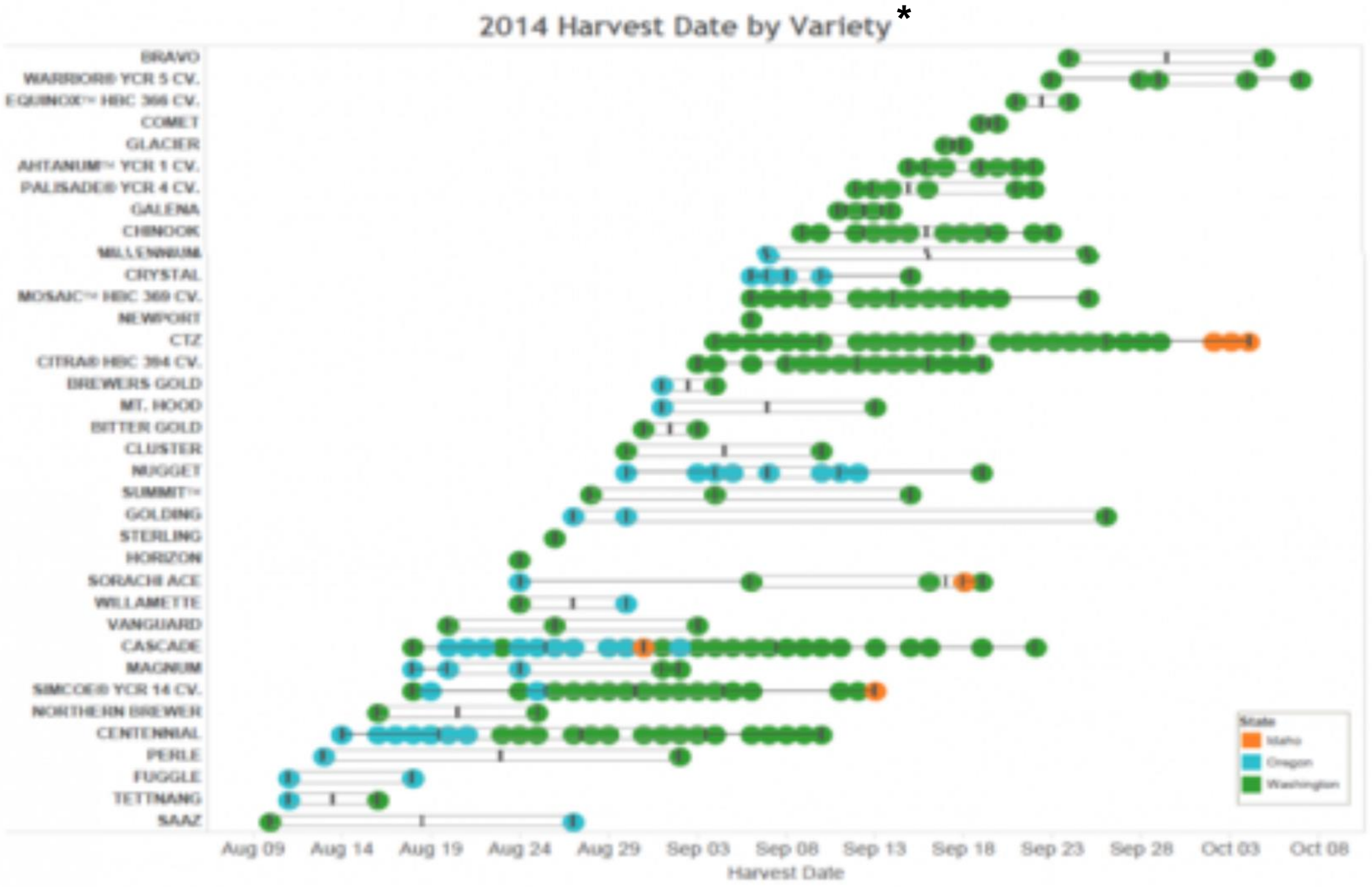
9. We like the **Neo-Mexicana**, but they are tough to grow

Harvest: August-September. Variety Dependent

Picking time of the most important cultivars



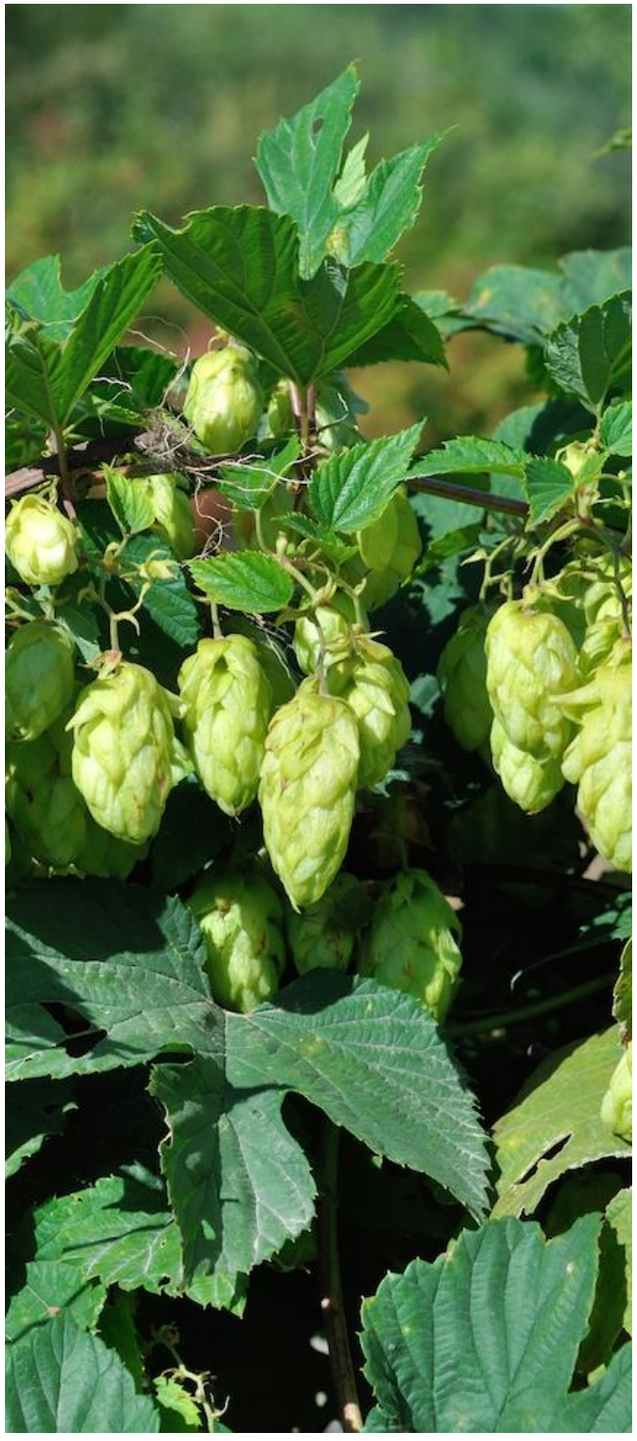
University of California
Agriculture and Natural Resources



***Your vision is fine**

University of California
Agriculture and Natural Resources

Photo credits: Zac German, Yakima Chief-Hop Union LLC, Great Lakes Hop and Barley Conference, Michigan 2015

University of California
Agriculture and Natural Resources

photocredits: NC Small Fruit and Veg IPM,StarkBros, [hopflavourblog.com](), [agroliquid.com]()

Harvest Options

1-2 weeks earlier in the valleys than the coasts

Mechanical: Wolf

Hand: “Brewery Team Building Day!”

Newer models?
hopsharvester.com

Photo credits: Imbibe Magazine, Cascade Hop Farm

Post Harvest

Fresh/ Wet Hops

Dried Whole-Cone Hops

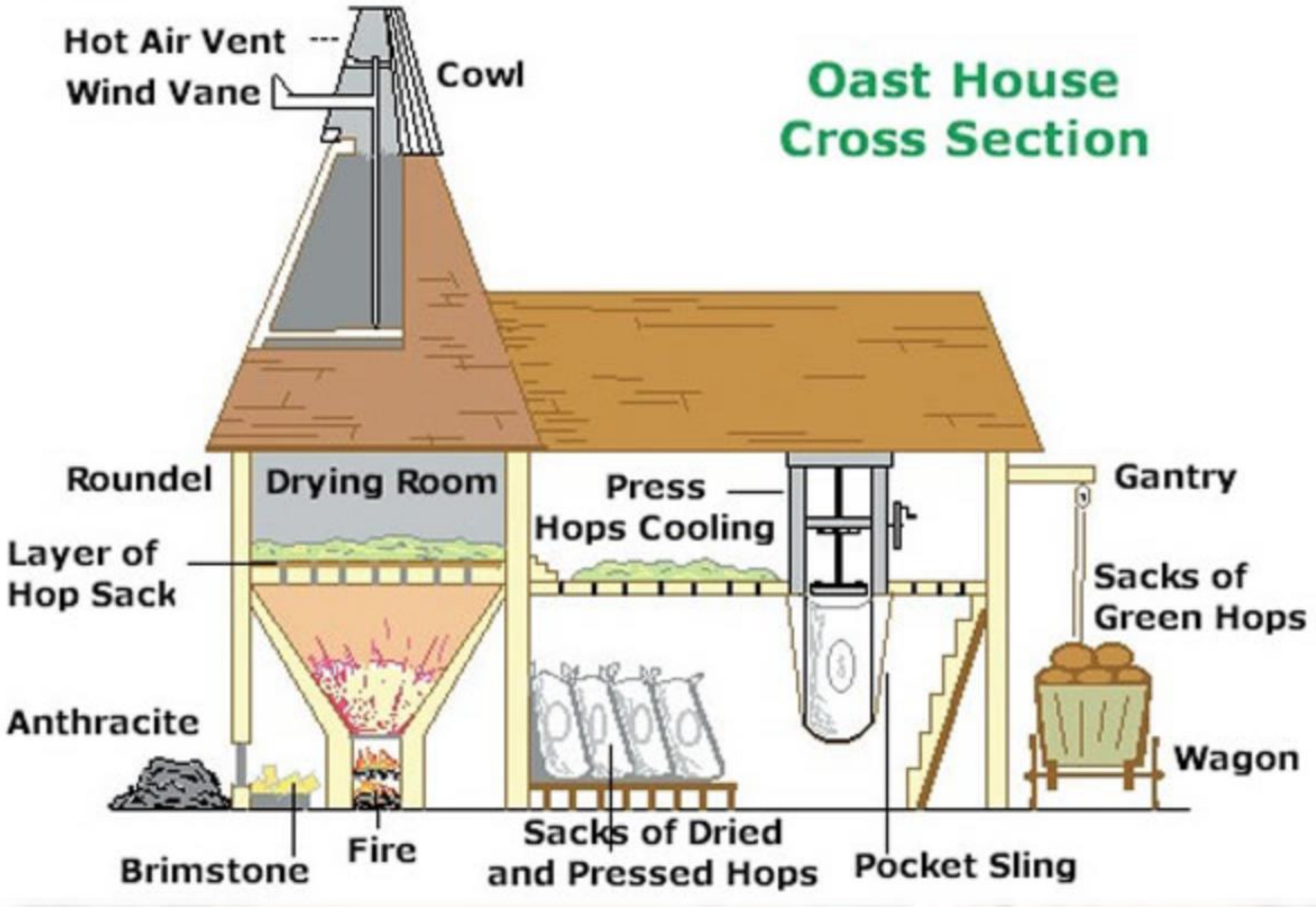
Pelletized

- **Timing is critical (24-48 hours max)**
- **Oxygen and moisture are you enemies**

University of California
Agriculture and Natural Resources

Photo credits: Bowmantown Hopyard, Amazon,com

Oast House Cross Section



Budget

Item	Year 1 (2016)	Year 2 (2017)	Year 3 (2018)	
Income				
Dried Hop Pellets (lbs./acre)	0	1100	1500	
acres	5	5	5	
$/lb.	$ 10	$ 10	$ 10	$
GROSS INCOME	**$ -**	**$ 55,000**	**$ 75,000**	**$**
Expenses				
Capital Purchase/Labor				
Hopyard Infrastructure (Appendix A)	$ 65,146			
Buildout Labor (Appendix B)	$ 24,880			
Equipment (Appendix C)	$ 46,000			
Sub-Total Capital Purchase & Labor (accounted for in loan- cell B41)	**$ 136,026**	**$ -**	**$ -**	**$**
Annual Expenses-Field				
Twine (2400 pre-cut 22' strings/bale=$400. ~$0.17/string)		$ 1,632	$ 1,632	$
Labor-Stringing ~(11.5 worker hrs/ac x $30/hr) $340/ac		$ 1,700	$ 1,700	$
Labor- Training ($150/acre) *variety dependent		$ 750	$ 750	$
Fertilizer & leaf feed (N,P,K,S,Zn,B, etc.) yr 1=$400/ac, yr 2+=$650/ac	$ 2,000	$ 3,250	$ 3,250	$
Chemicals (all pesticides) yr 1= $500/ac, yr 2+=$750/ac	$ 2,500	$ 3,750	$ 3,750	$
Labor- Spraying ($30/hr x .3 hrs/ac). Yr 1=12, yr 2+=20 sprays	$ 540	$ 900	$ 900	$
Labor- Field Harvest ($800/ac)		$ 4,000	$ 4,000	$
Disking ($128/ac)	$ 1,280	$ 1,280	$ 1,280	$
Tractor Fuel & Oil (gasoline, diesel, propane, etc.) $150/ac	$ 750	$ 750	$ 750	$

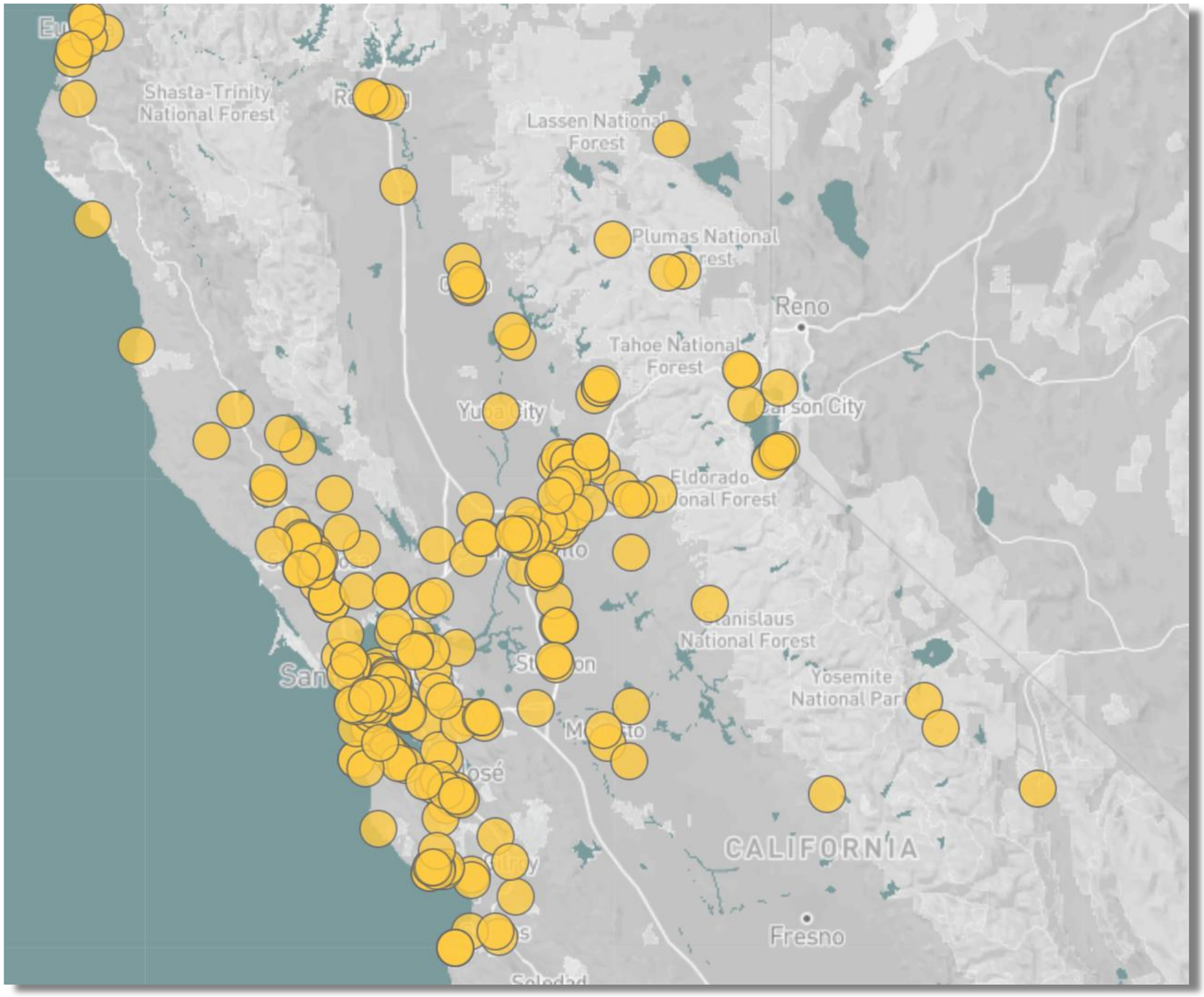
lb./ac and $/lb. scenarios (year 5)

	Price/lb.				
Yield (lbs./acre)	$6.00	$8.00	$10.00	$12.00	$14.00
800	$ (15,941)	$ (14,341)	$ (12,741)	$ (11,141)	$ (9,541)
1000	$ (14,741)	$ (12,741)	$ (10,741)	$ (8,741)	$ (6,741)
1200	$ (13,541)	$ (11,141)	$ (8,741)	$ (6,341)	$ (3,941)
1400	$ (12,341)	$ (9,541)	$ (6,741)	$ (3,941)	$ (1,141)
1600	$ (11,141)	$ (7,941)	$ (4,741)	$ (1,541)	$ 1,659
1800	$ (9,941)	$ (6,341)	$ (2,741)	$ 859	$ 4,459
2000	$ (8,741)	$ (4,741)	$ (741)	$ 3,259	$ 7,259
2200	$ (7,541)	$ (3,141)	$ 1,259	$ 5,659	$ 10,059

University of Vermont/ USA Hops:
https://www.usahops.org/growers/cost-of-production.html

University of California
Agriculture and Natural Resources

Markets



source: https://projects.sfchronicle.com/2017/brewery-map/

- **Majority of Hops in California are sold fresh (better premiums)**

- **Some brewers have paid $11/lb (wet weight!) for small batches**
  - This is a closer price for dry weight otherwise

- **Drying, pelletizing, and refrigeration greatly increase shelf life**

- **Scale is critical**

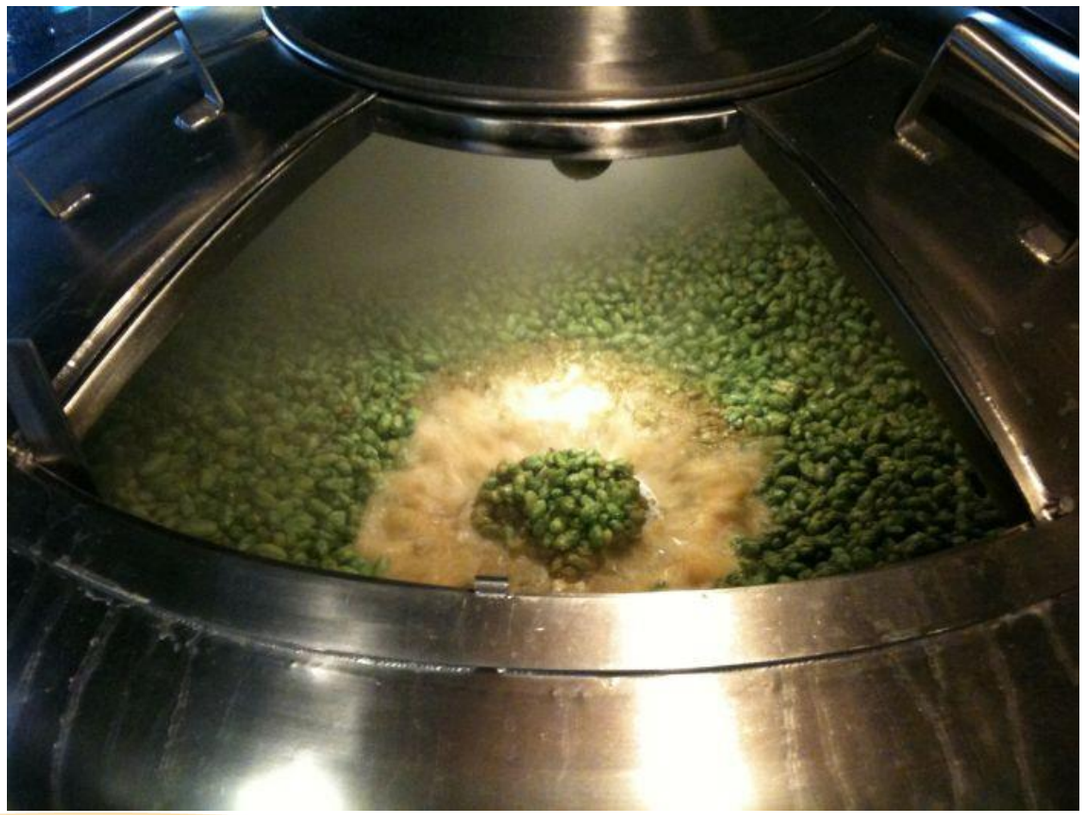
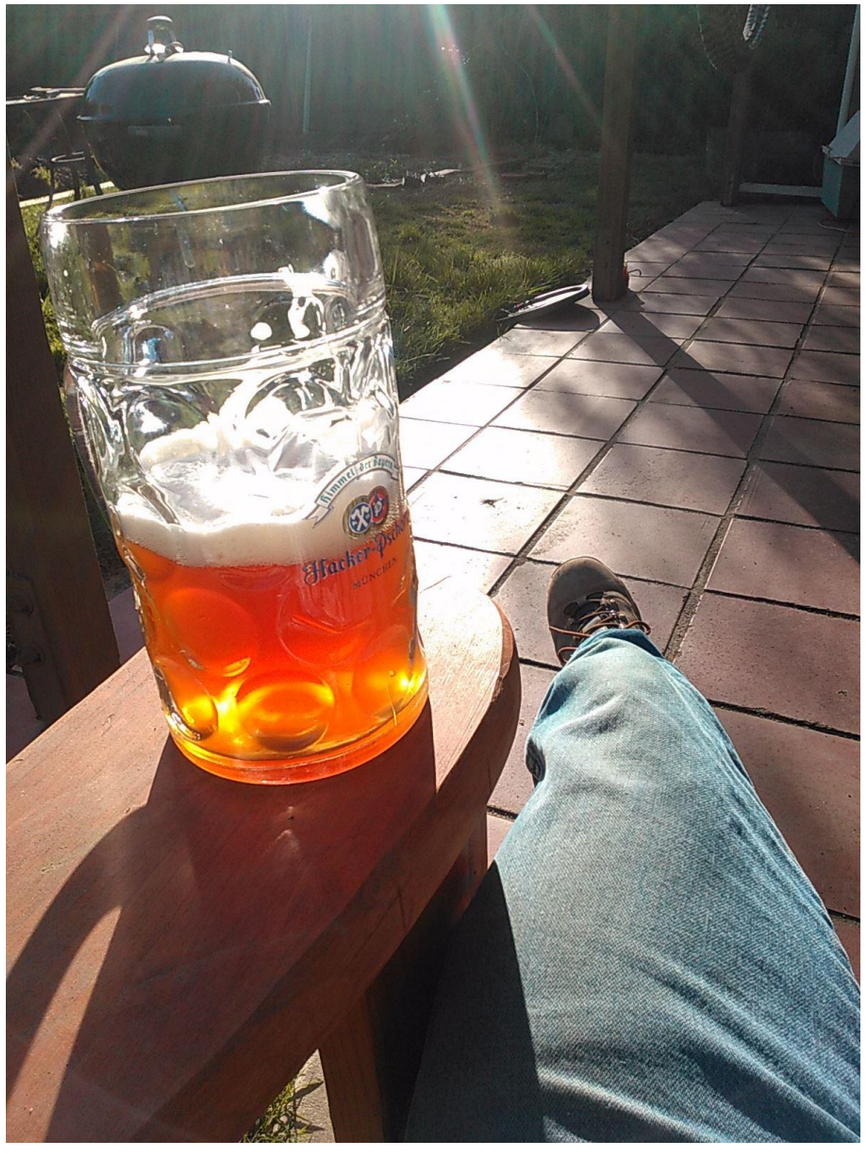


Photo credits: brewpublic.com

Cheers!

Konrad Mathesius
530.218.7567
kpmathesius@ucanr.edu



University *of* California
Agriculture and Natural Resources