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Introduction to hops

GREAT LAKES HOP AND BARLEY CONFERENCE
TRAVERSE CITY, MI
FEBRUARY 28, 2019

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Dan Wiesen, Empire Hops
Alex Adams, Cedar Hop Farm

OUTLINE

1. Introduction
2. Hopyard construction
3. Stages of Production
   - Dormancy
   - Spring Regrowth
   - Vegetative Growth
   - Reproductive Growth
   - Preparation for Dormancy
4. Harvest & Post-Harvest
5. Hop Enterprise Budget
6. Take Home Messages

Factors that can impact hop production (growth, yield, and quality)

Environmental (temperature, day length, soil texture, weather)

- Day length divides production stages (photoperiod sensitive)
- Latitude determines day length
- Heat determines growth during each stage

Production Practices

- Cultivar
- Soil fertility
- Disease, pest, and weed pressure and control
- Training and timing of training
- Harvest and harvest timing
- Irrigation
- Post-harvest processing and storage

Biological basis of production & environmental factors result in:

Stages of Production

- Dormancy
- Spring regrowth
- Vegetative growth
- Reproductive growth
- Preparation for dormancy

Each stage requires its own unique management regime

March				April				May				June				July				August				September			
1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
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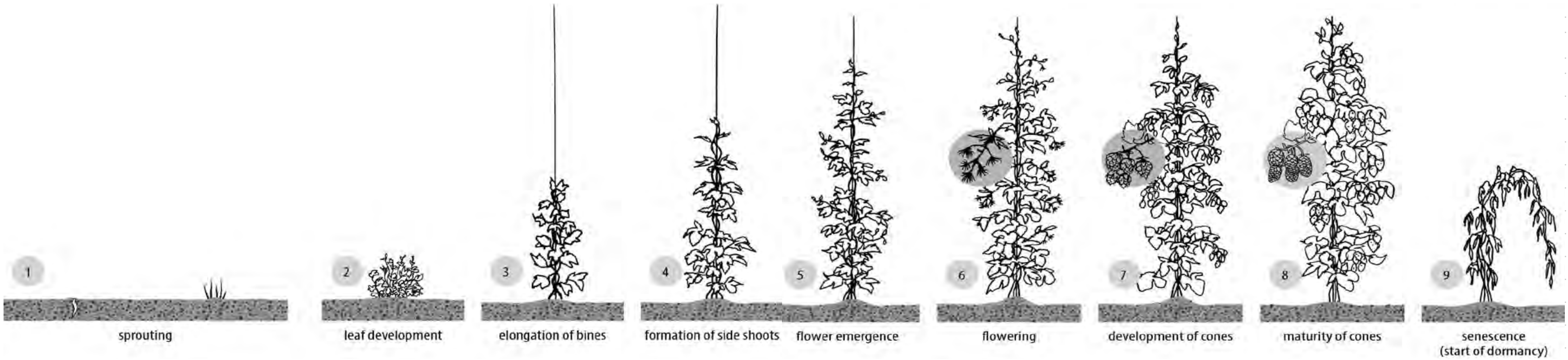
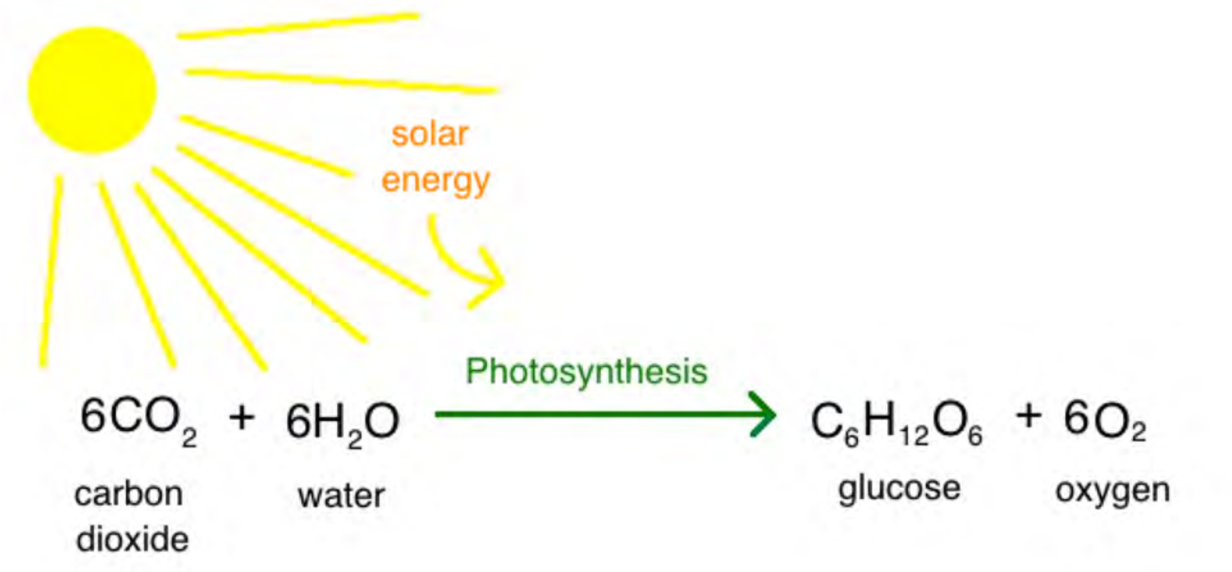
					sprouting		leaf development					side shoots			burr stage		flowering		cone development			maturity of cones					
									elongation of bines																		



Dormancy (October-March)

- Late summer plant allocates photosynthetically derived starches to the storage roots
- Starch is converted to soluble sugars
- Sugars are the energy the plant needs for spring regrowth



Dormancy cont.

Williams et al. 1961. Dormancy of established plants involves 2 major stages.

1. Onset of dormancy

- Onset of dormancy initiated by changes in daylength
  - death of the shoots and the finer root system
  - transfer and accumulation of food reserves in the storage roots
  - development of relatively large resting buds below soil level.

2. Breaking of dormancy

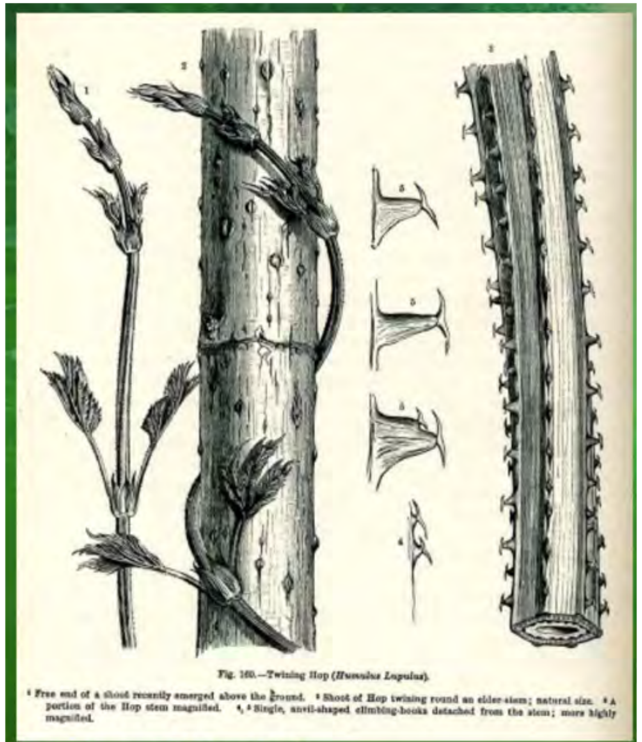
- gradual removal of growth inhibition
- considered complete when resting buds will break into new growth as climatic conditions permit

Agnus, 14 years – root system after spatial reconstruction

Saaz, 15 years, excavation work
Žatecký poloraný červeňák, 15 let, výkopové práce

Climbing Bines

- Bine climbs clockwise with the aid of trichomes
  - Phototropism
  - Thigmotropism
- In the wild, hops climb up a companion species or support
- Commercial production requires a trellis
- Hops grow clockwise



Anton Kerner von Marilaun (1895)


Photo Credit: Rogue Farms

Hopyard Construction

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Dan Wiesen, Empire Hops

Terminology

- **Anchor Poles-**Poles at the exterior or trellis and attached to anchor pins.
- **Field Poles-**Interior poles that he cross wire sits on
- **Anchor Pin-** Steel rods that are concreted into the ground that anchor cable is secured to
- **Cross Wire-** Steel cable that runs from anchor poles over field poles to support vine line
- **Vine Line-** Steel cable that runs over cross wire and attaches to bridle on each side of trellis. This is the cable that strings are attached to
- **Bridle-** Doubled up steel cable that runs on the exterior of trellis along two opposite sides (ideally North and South) that vine lines attach to
- **Ribbon-** Steel cable that runs on exterior of trellis opposite of bridle
- **Wiggle Wire-** 18” long 9 gauge wire to hold vine line in place

Field Preparation

- Clearing Land – Remove any unwanted trees and under brush
- Disc Field- Field must be leveled and soil softened to allow for marking with GPS tractor
- Fumigation- Easiest if done at this point but can be done later

Trellis Construction: Required Materials

- Southern Yellow Pine (Anchor Poles)
- Red Pine (Interior Poles)
- 5/16” Cable (Bridle, Crosswire, Ribbon, and Anchor Cable)
- 1/4” Cable (Vine Line)
- 5’ Anchor Pins (5’ Steel rod with an eye hole at the top and a shepherds hook on the bottom)
- 5/16” Clamps
- 1/4” Clamps
- 3” Staples (Attaching Cross wires to Interior Poles)
- 1 3/4” Staples (wrapping cables to Anchor Poles)
- 6” Nails (Establishing wrap on Anchor Poles)
- Wiggle Wire

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Table 1. Typical row and plant spacing in various hop-producing regions of the world (Oldham 2016; Kořen 2007; Rybáček 1991).

Country	Region	Dominant growing system*	Typical spacing between rows (m)	Typical plant spacing along the row (m)
Germany	Hallertau	V-trellis	3.2	1.3–1.7
USA	Washington State	V-trellis	4.0	0.9
Czech Republic	Saaz, Trschitz and Auscha	V-trellis	3.0	1.0
United Kingdom	West Midlands and south-east	Low 2D trellis	2.5	0.6–0.9
New Zealand	Nelson	V-trellis	2.5	1.2

Note: The openness of the V-trellis systems varies considerably from country to country with differences in row spacing. V-trellis canopies in Washington State, USA are much wider than those in Germany or New Zealand.

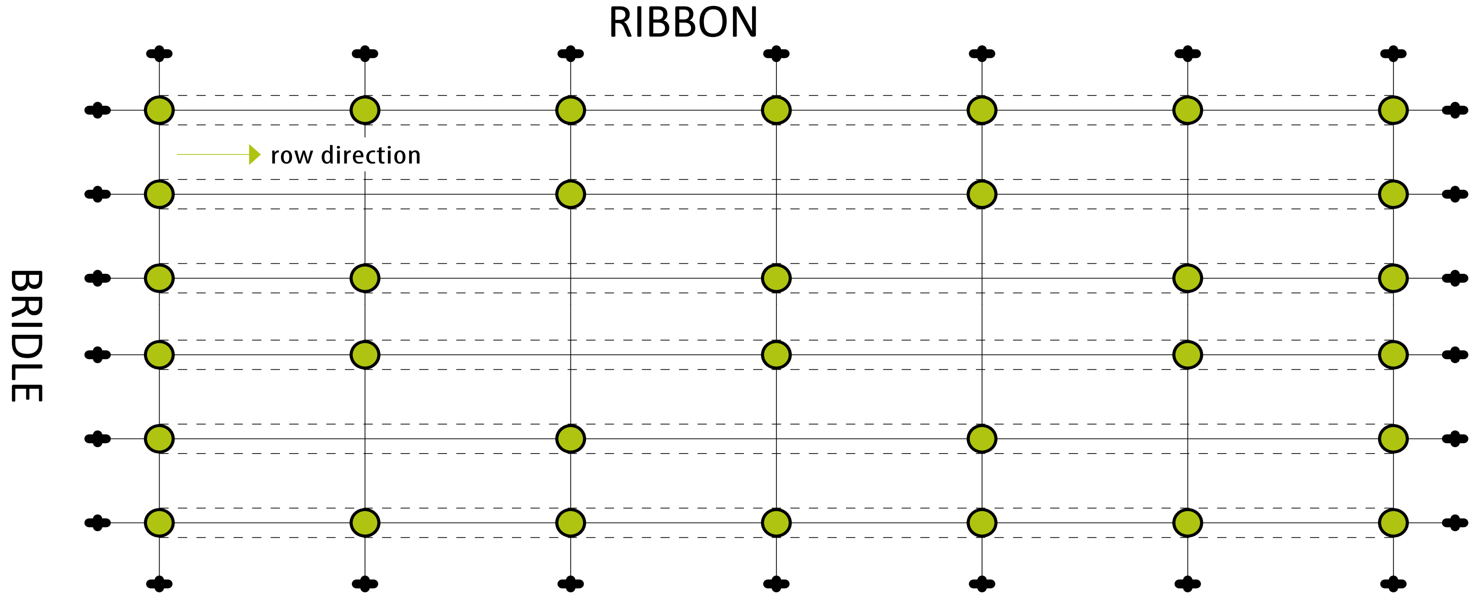


Figure 4. A possible hop yard design plan showing distribution of posts, cables, wires, stays and anchors.

posts ground anchors --- wire — cable

14’ x 3.5’ (2 strings/hill)

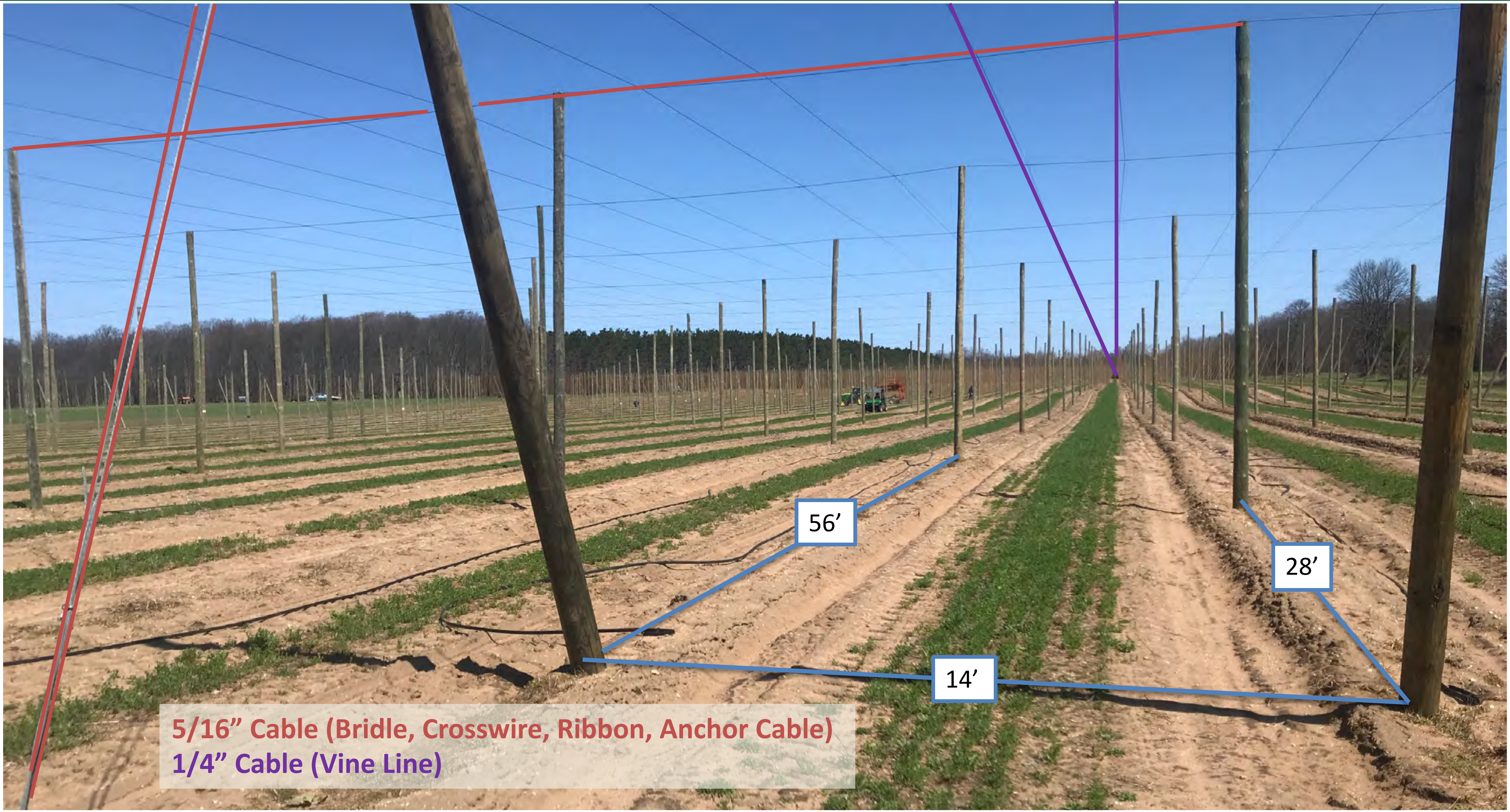
889 hills/ac

14’ x 7’ (4 strings/hill)

445 hills/ac

55 poles

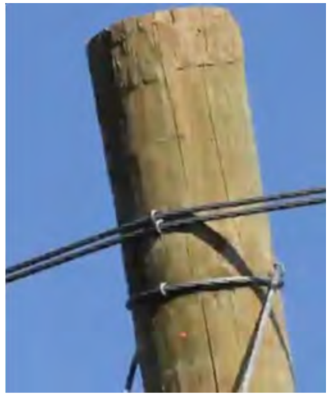
1778 strings/acre


56’
28’
14’
5/16” Cable (Bridle, Crosswire, Ribbon, Anchor Cable)
1/4” Cable (Vine Line)

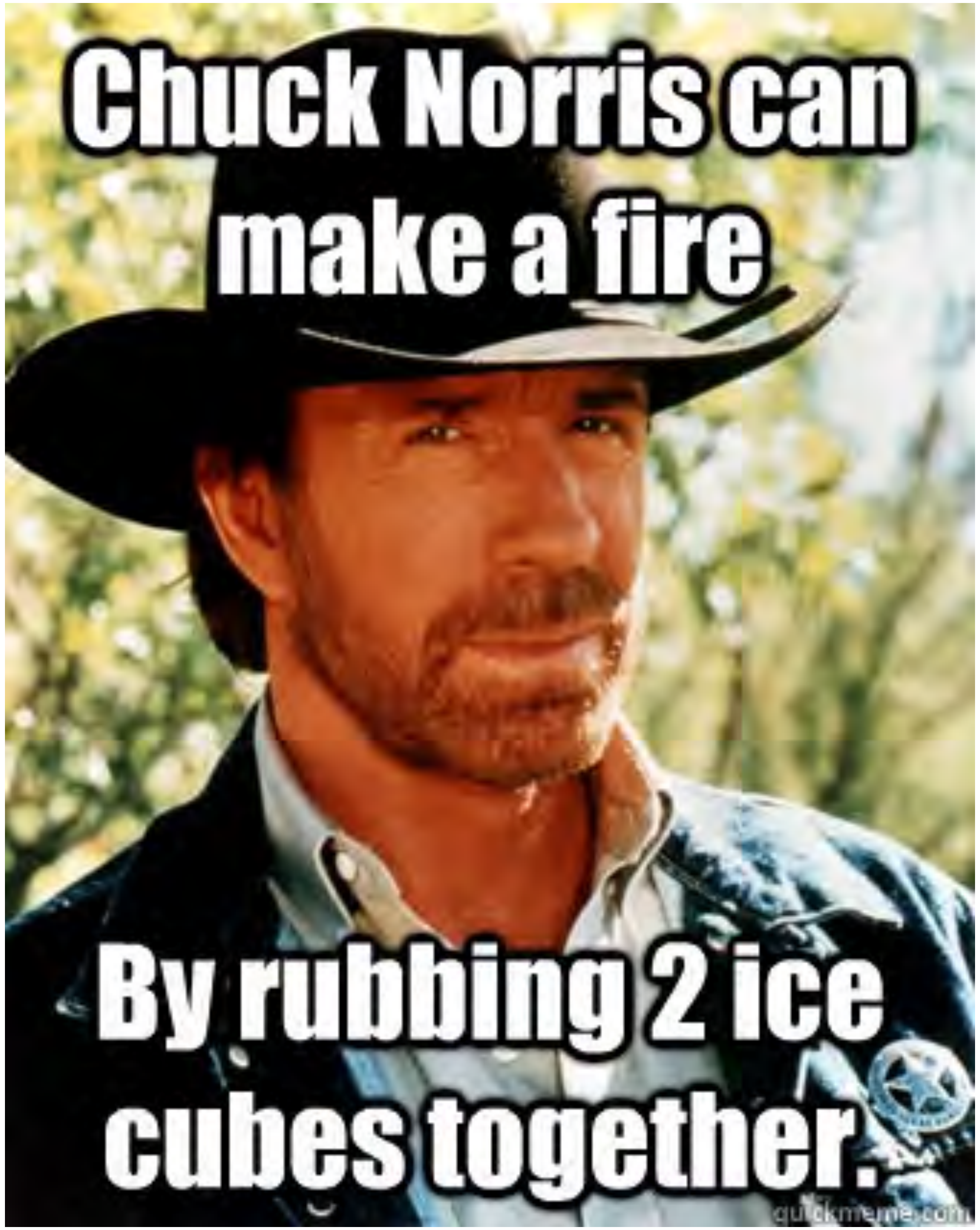


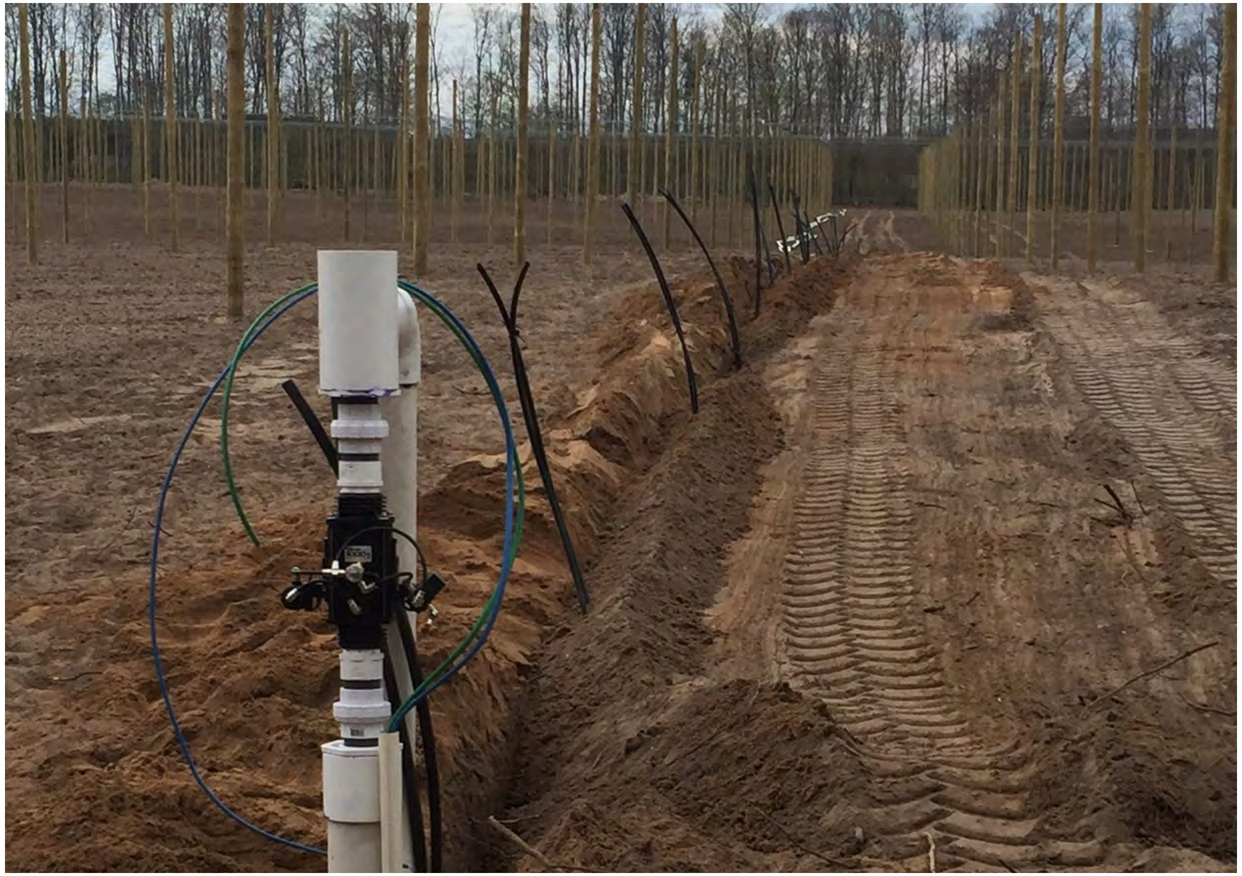




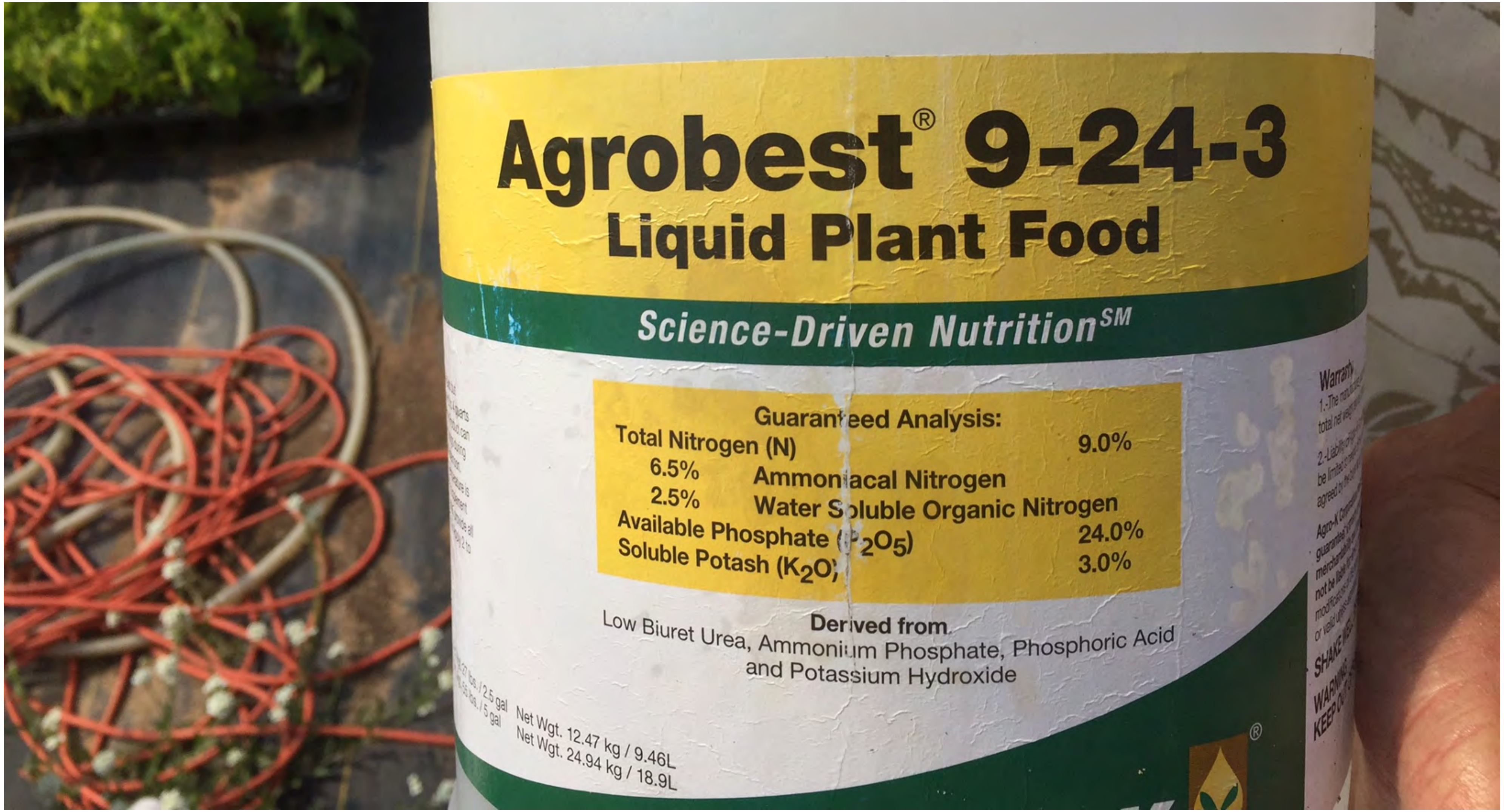




Chuck Norris can make a fire
By rubbing 2 ice cubes together.
quickmeme.com



Planting

- Planting is done manually
- Plant spacing: 3.5’ from the post and then 7’ after that
- This comes into play when stringing in the spring
- Planting is labor intensive but moves quickly with a crew of 10 (10-12 acres/day)


Agrobest® 9-24-3
Liquid Plant Food
Science-Driven Nutrition℠
Guaranteed Analysis:
Total Nitrogen (N) 9.0%
6.5% Ammoniacal Nitrogen
2.5% Water Soluble Organic Nitrogen
Available Phosphate (P_2O_5) 24.0%
Soluble Potash (K_2O) 3.0%
Derived from
Low Biuret Urea, Ammonium Phosphate, Phosphoric Acid and Potassium Hydroxide
Net Wgt. 12.47 kg / 9.46L
Net Wgt. 24.94 kg / 18.9L
Warranty

March				April				May				June				July				August				September			
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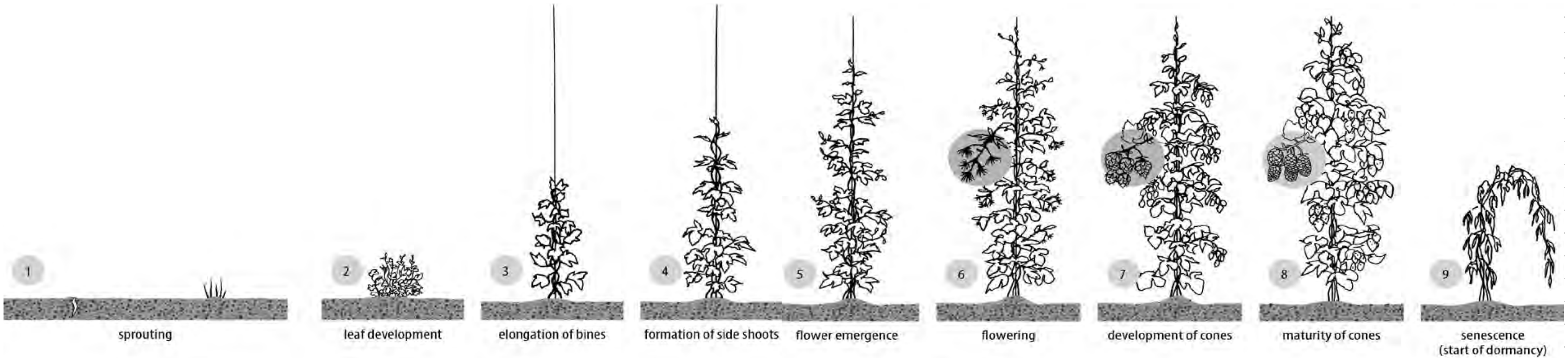

Spring Regrowth (March-April-May)

Increasing day lengths and temperatures-signal for end of dormancy

- Plant uses soluble sugars as energy to emerge from dormancy and begin regrowth
- Initial regrowth- rapidly producing vines unsuitable for production
- Plant relies on energy reserves of the root until end of May, when the starches and sugars reach their lowest points of the year
- Supplemental nutrient management is needed to maximize plant health beginning in late May
- Yield already being determined April-May

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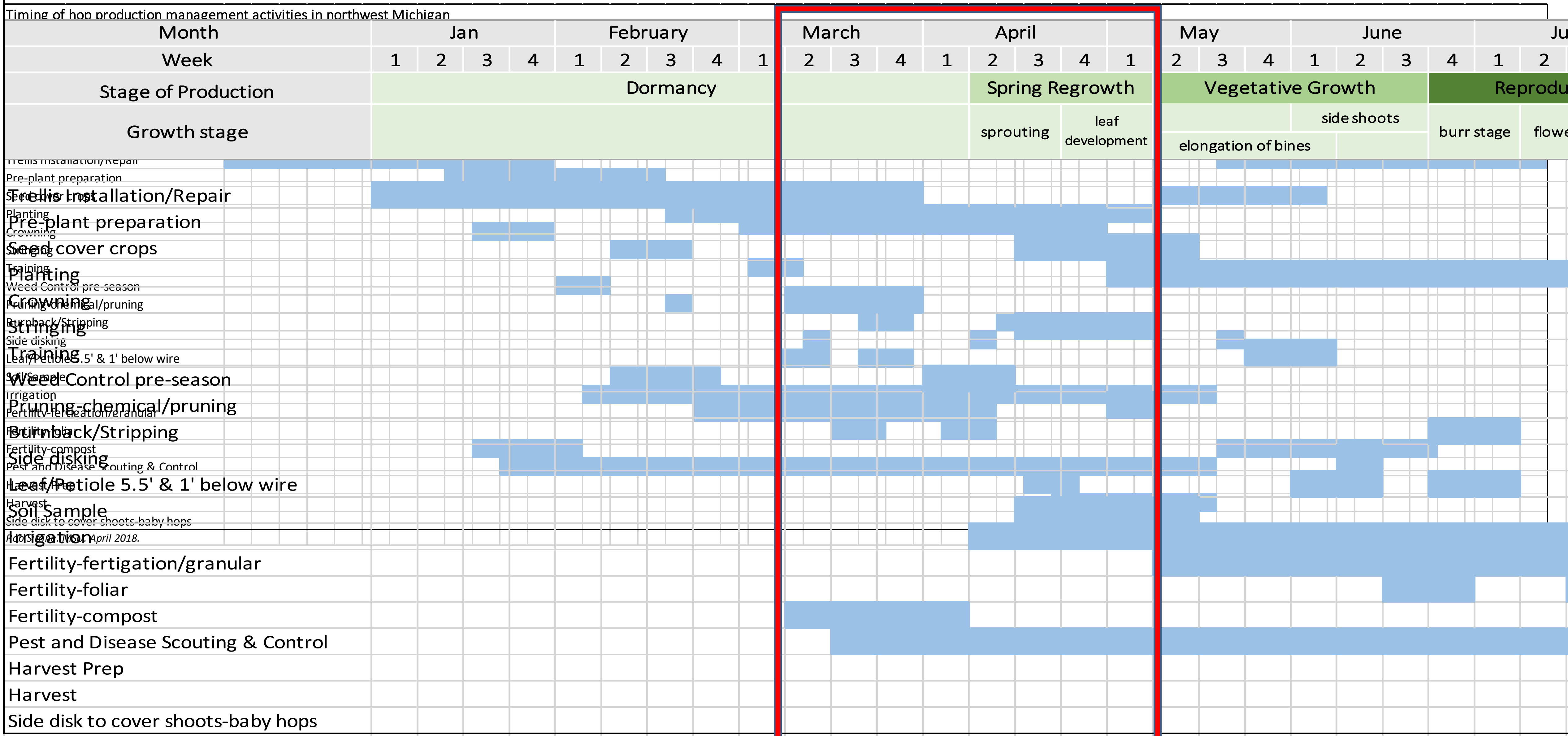
Timing of hop production management activities in northwest Michigan



Rob Sirrine. MSU. April 2018.

- Dormancy
- **Spring regrowth**
- Vegetative growth
- Reproductive growth
- Preparation for dormancy
- Dormancy

Spring Regrowth

Spring Regrowth (March-April-May)

In the field

- Compost (applied in Fall)
- If planting-plant into fall seeded cover crops
- Soil testing
- Pruning (late April-early May, 1 month prior to training)
- Weed Control
- Twining/Stringing-prior to rolling out irrigation
- Irrigation begins in May (2-3 hours/day until mid-June)

Spring Work in Oregon Hop Fields

https://www.youtube.com/watch?v=2JesefwTnbg

DK FAB Hop Crowner

https://www.youtube.com/watch?v=bde9Cq5UyVI

Spring Regrowth

In the Field: Pruning

- Spring removal of plant and crown material - important in established hop yards
- Generically referred to as "pruning", (mech. or chem.)
- Mechanical pruning = physical removal of shoots associated crown buds from the current or previous season
- Multiple ways of mechanical pruning
  - "crowning" or "cutting"
  - "scratching"- less aggressive
- Crowning involves removal of the top 2-5 cm of the new wood formed in the previous season (i.e., part of the "crown") with an offset implement.
- Important for P.M. control that can be stored in overwintering buds near the surface

Figure 1. Hop crowning. *Photo Credit: Dr. Dave Gent, USDA ARS*

Figure 2. Recently crowned Oregon hop yard. *Photo credit: Dr. Dave Gent, USDA ARS*

Spring Regrowth

In the Field: Pruning cont.

- Pruning can have a major impact on hop yield and quality
- Methods & timing depend on: grower preference, irrigation placement/practice, cultivar, yard age & vigor, latitude & location, timing, disease severity from the previous season, and seasonal growing conditions
- **No substitute for local trials and experience to determine optimum method and timing**
- **When producing a new variety, it is advisable to experiment with varying pruning dates (and by consequence then, training dates) over a period of several weeks to observe how plants respond**

Spring Regrowth

In the Field: Pruning- can determine training date

- Depend on plant vigor
  - Some varieties want to hold back
  - Some varieties want to get to top wire asap
- Could also depend on specific block (eg. weak centennial block may train earlier)
- Depends on desired harvest time

Variety	Chem Pruning Dates	Training Dates	Harvest Dates
Willamette	4-12	5-1 / 5-3	8-24 / 8-29
Cascade	4-12	5-4 / 5-7	9-3 / 9-23
Cluster	4-17	5-7 / 5-8	8-29 / 9-10
Millenium	4-18	5/10	9-3 / 9-28
Citra	4-18 / 4-26	5-10 / 5-15	9-3 / 9-18
Equinox	4-26	5-16 / 5-17	9-20 / 9-23
Mosaic	4-26 / 4-28	5-15 / 5-20	9 -5 / 9-23
Zeus	4-28 / 4-30	5-19 / 5-20	9-3 / 9-30

Spring Regrowth
In the Field: Stringing

- Stringing begins as soon as the ground has thawed (April)
- Two people in the tower tie two strings each moving across the drive rows
- A team on the ground pushes the strings through the hop plant and into the ground
- The string is held in the ground with "W" clips
- The spacing of the plants matches the spacing of the strings

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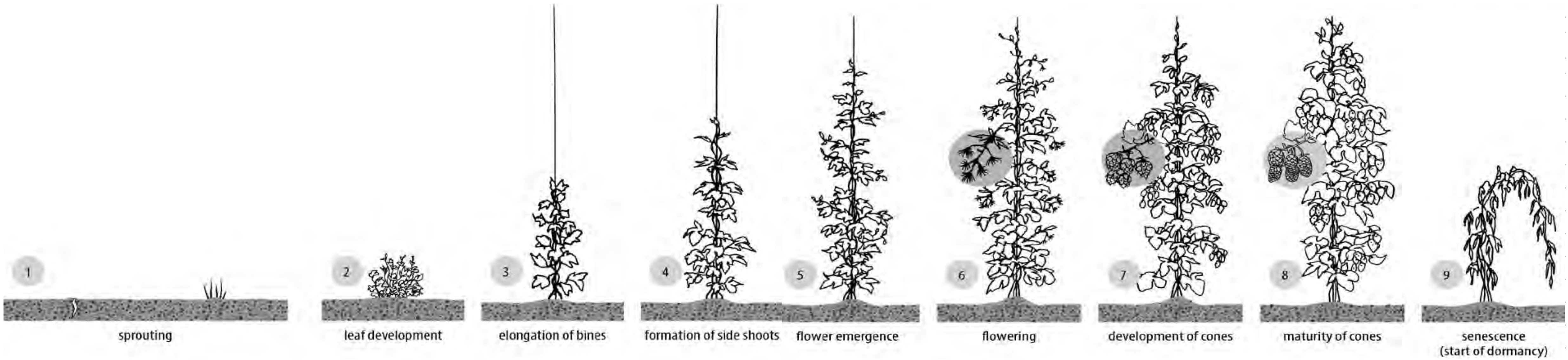


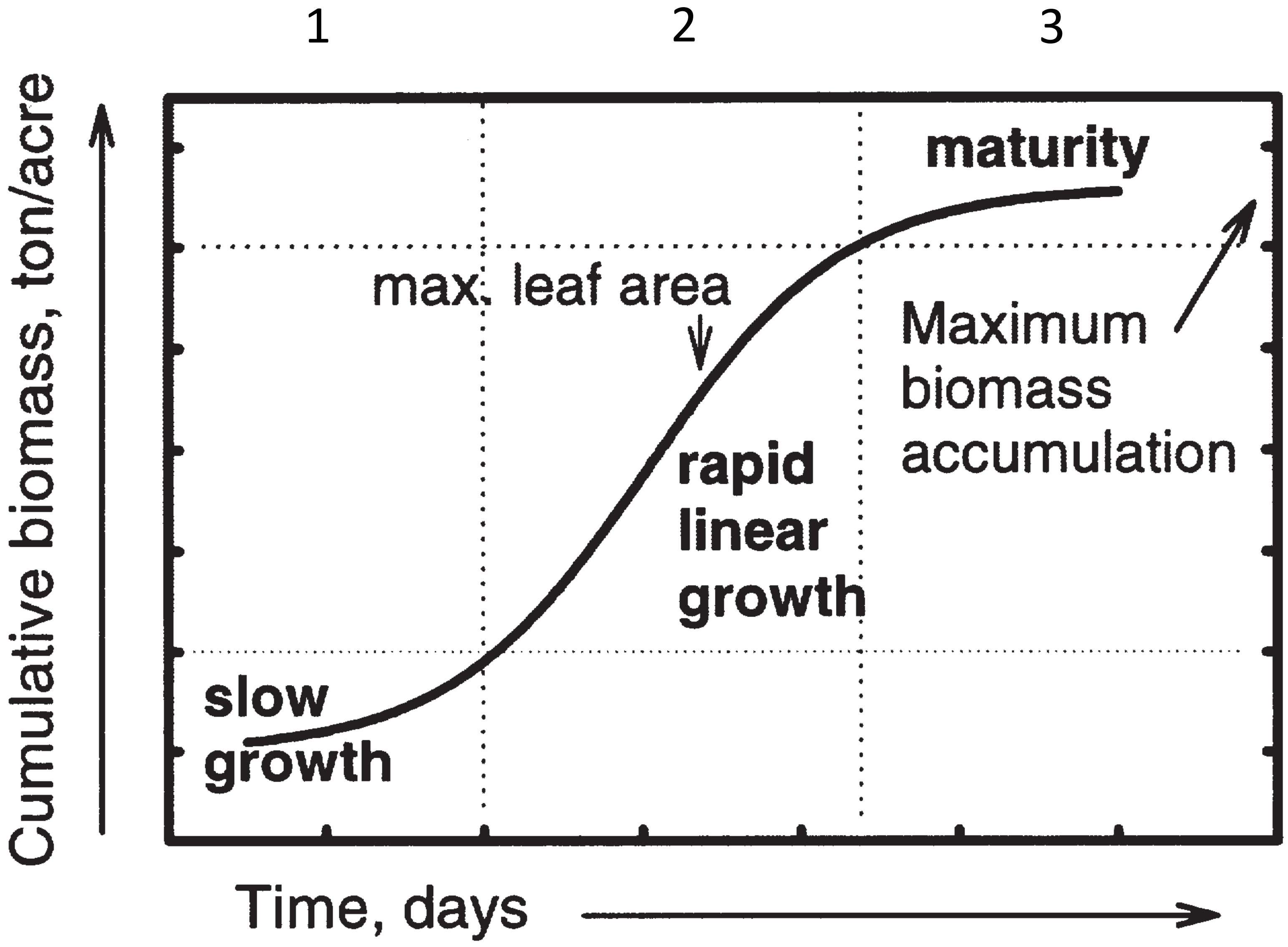
Vegetative Growth (May-July)

Critical Stage for the purposes of crop production, occurs from end of May-end of July

Two Phases:

1. May-early July: Plant growth mainly in main vine and leaves
2. July: Bulk of above ground growth occurs in the lateral production (side arms)
   - Plant reserves used up
   - Plant already determining yield

Cumulative biomass accumulation

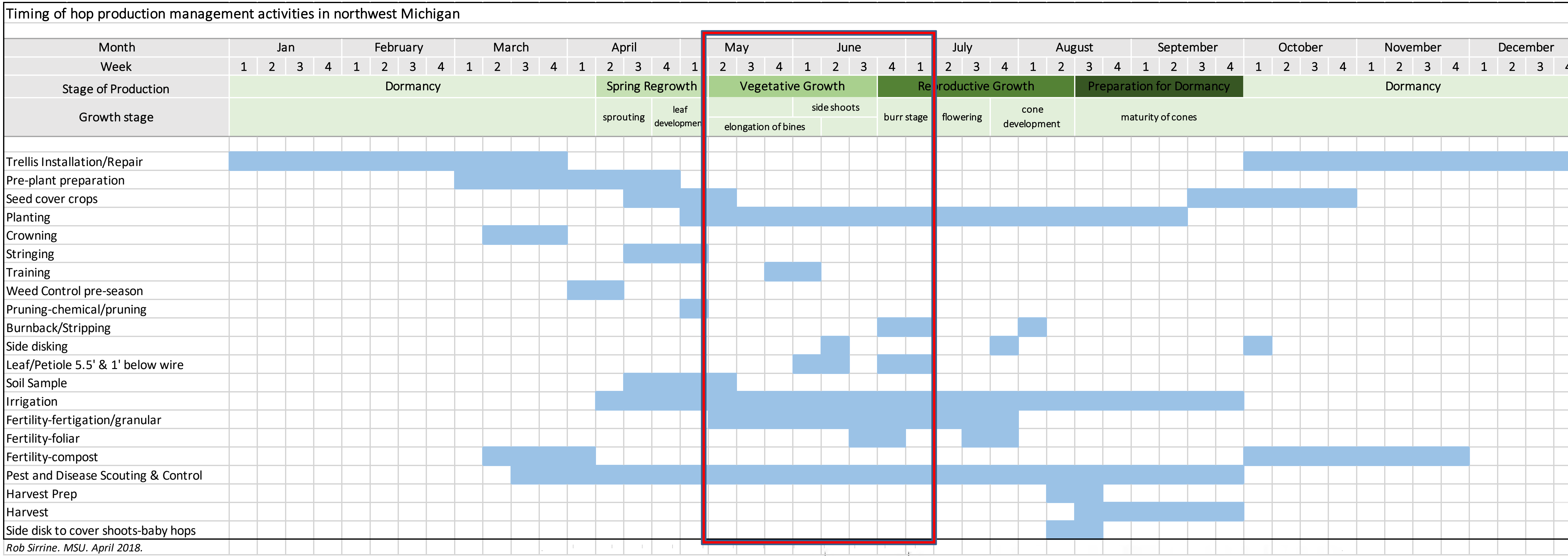


Vegetative Growth cont.

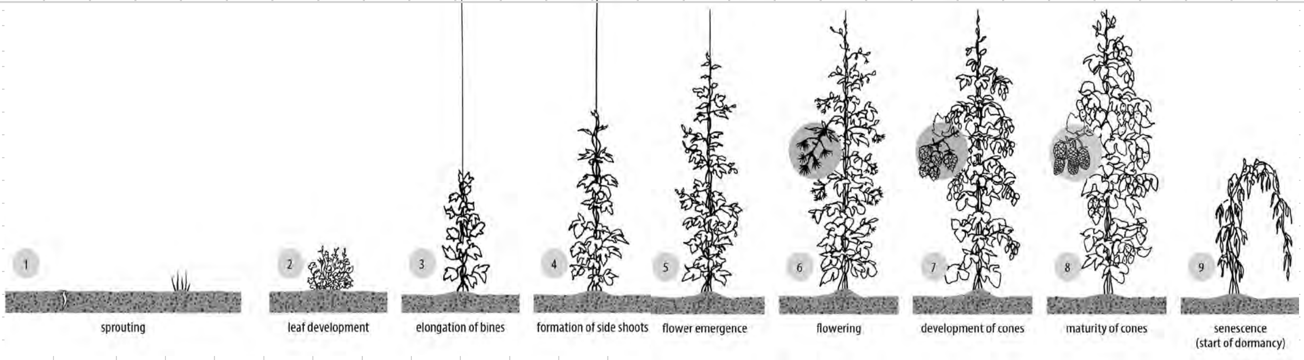
- Intensive growth of shoots
- Leaf surface area rapidly increases
- photosynthetic productivity increases
- reserves accumulated in underground organs from preceding year are still involved

Shoot Stage

Burr Stage



- Dormancy
- Spring regrowth
- **Vegetative growth**
- Reproductive growth
- Preparation for dormancy



Mid-June

End July

October

June 20, 2018

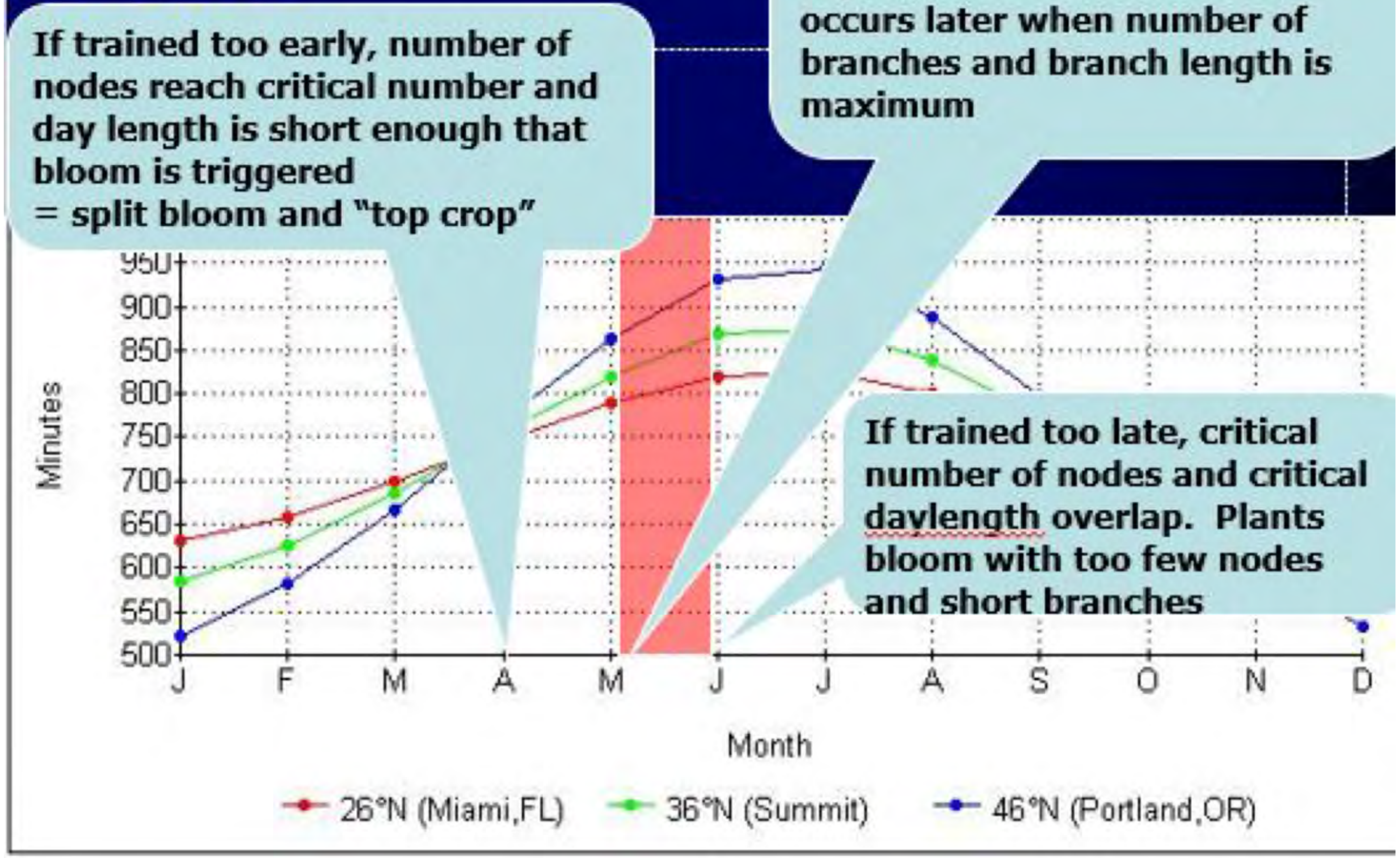
Vegetative Growth(May-July)

In the Field: Training

https://youtu.be/z9OqXOgdkMc

- Training begins June 1
- 2-4 vines wrapped clockwise around string
- # of vines depends on cultivar
- Vines have ~1 month to hit top wire
- Training-labor intensive (8-15 people)
- Crew of 10 can train ~ 10 ac/day

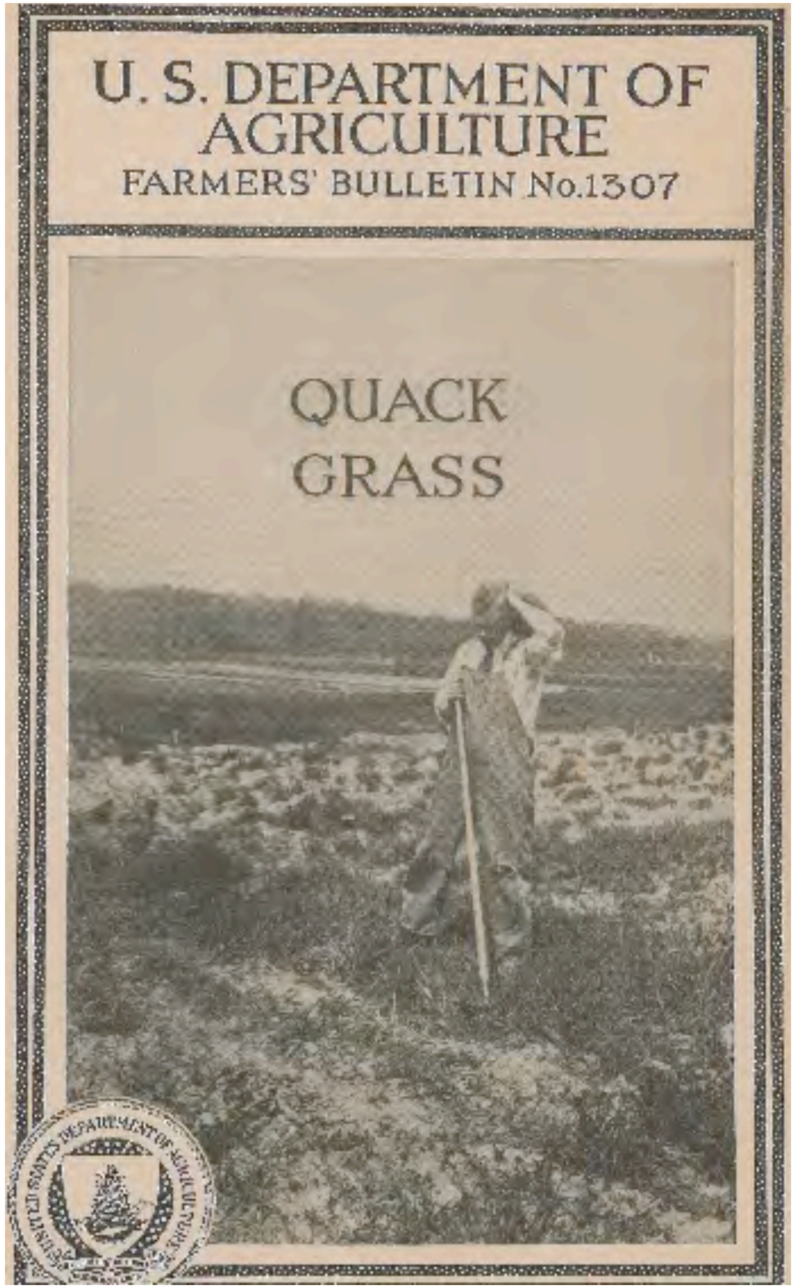
Day length and Nodes



Vegetative Growth(May-July)

In the Field

- IPM-monitor, monitor, monitor
- Pest/Disease/Weed Control
- Aggressive management!!
- Maximize health of plant & growth
- Fertility Management
- Some growers apply foliar N
    - bines are ½ way up string (mid-June)
- Irrigation



Weed Control

Fertility

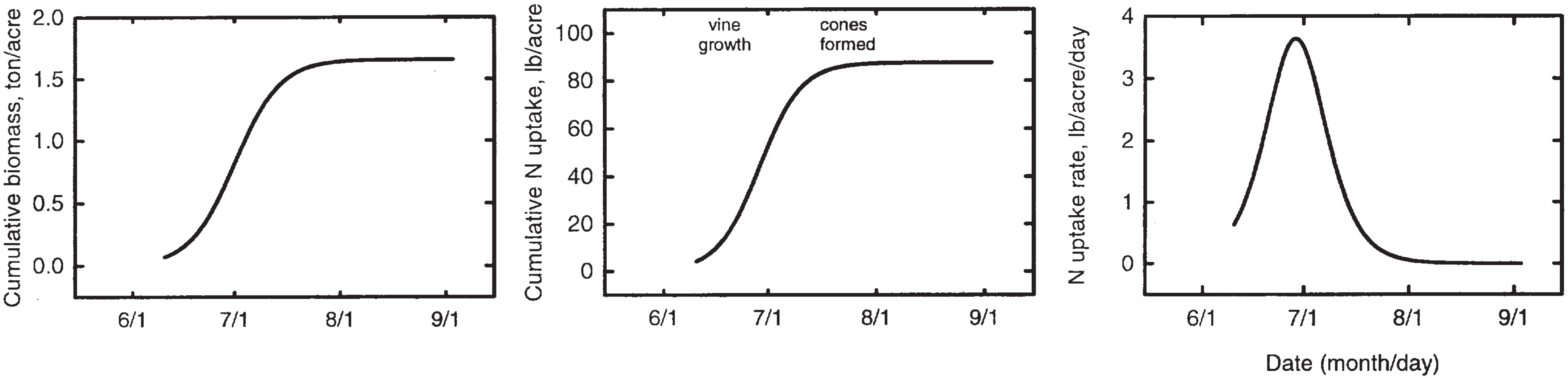
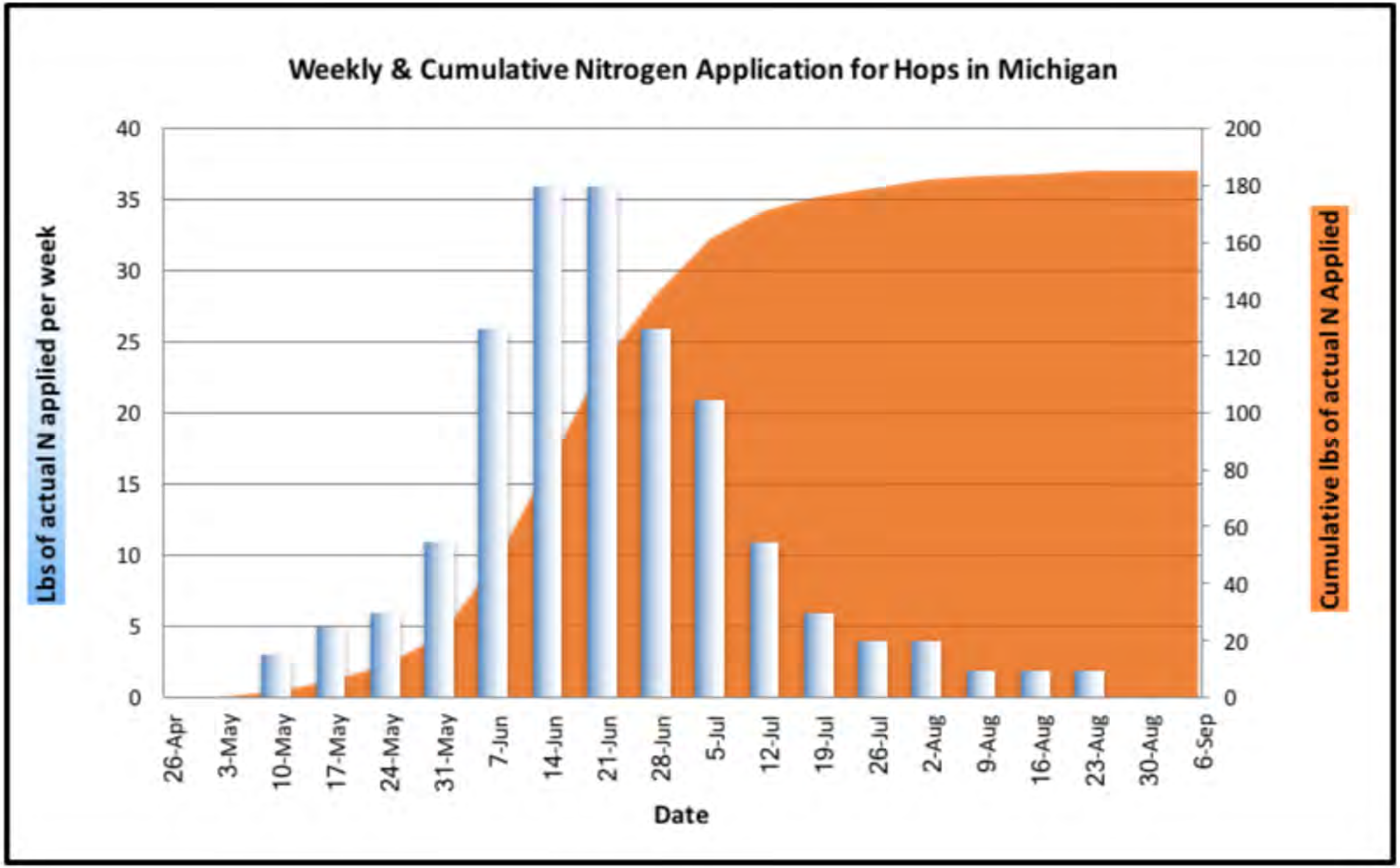


Figure 4.—Biomass accumulation and N uptake for hops grown in the Willamette Valley. Combined data from two field locations (1991). Source: N.W. Christensen, M.D. Kauffman, and G. Gingrich, Oregon State University.


Weekly & Cumulative Nitrogen Application for Hops in Michigan
Lbs of actual N applied per week
Cumulative lbs of actual N Applied
0
5
10
15
20
25
30
35
40
0
20
40
60
80
100
120
140
160
180
200
26-Apr
3-May
10-May
17-May
24-May
31-May
7-Jun
14-Jun
21-Jun
28-Jun
5-Jul
12-Jul
19-Jul
26-Jul
2-Aug
9-Aug
16-Aug
23-Aug
30-Aug
6-Sep
Date

Phosphorous
- Requirements low when compared to N and K
- 9-10 bale/ac yield only removes 20-30 lbs of P/ac

Potassium (K)
- Hops take up 80–150 lb K/a.

Boron
- In western Oregon hopyards, boron applications are recommended when values are 1.5 ppm or below.

Zinc
- Required for optimum growth. Zn deficiency is associated with high soil pH >7.5

Petiole/Leaf Testing

Optimum Nutrient Ranges				
		Plant Analysis Handbook IV		Western Labs 5.5 ft above ground
NUTRIENTS	JOHN I HAAS	Vegetative Stage Pre-Bloom	Reproductive stage & Full Bloom	
Nitrogen (%)		3.2 - 5.6	2.13 - 3.93	> 4.0
Potassium (%)	1.49 - 2.5	1.6 - 3.4	0.97 - 2.55	> 4.0
Phosphorous (%)	0.29 - 0.6	0.27 - 0.54	0.18 - 0.43	> 0.85
Calcium (%)	0.79 - 1.2	1.03 - 2.57	3.09 - 6.05	> 0.25
Magnesium (%)	0.24 - 0.8	0.29 - 0.67	0.55 - 1.71	> 0.4
Manganese (ppm)	25 - 150	45 - 125	50 - 150	> 85
Iron (ppm)	30 - 60	44.3 - 97.9	35.4 - 151	
Copper (ppm)	10 - 25	8 - 29	5.7 - 16.6	> 10
Boron (ppm)	24 - 75	17.6 - 63.2	48 - 150	> 55
Zinc (ppm)	24 - 50	23.2 - 108	19.4 - 57.1	> 60
% Sulfur Sampled Basis	0.16 - 0.32	0.2 - 0.34	0.18 - 0.30	> 0.25
% Sulfur Dry Matter Basis	0.16 - 0.32	0.2 - 0.34	0.18 - 0.30	
Mo		0.5 - 3	1 - 5	
Na	0 - 1400			
NO3 ppm	4000-12000			

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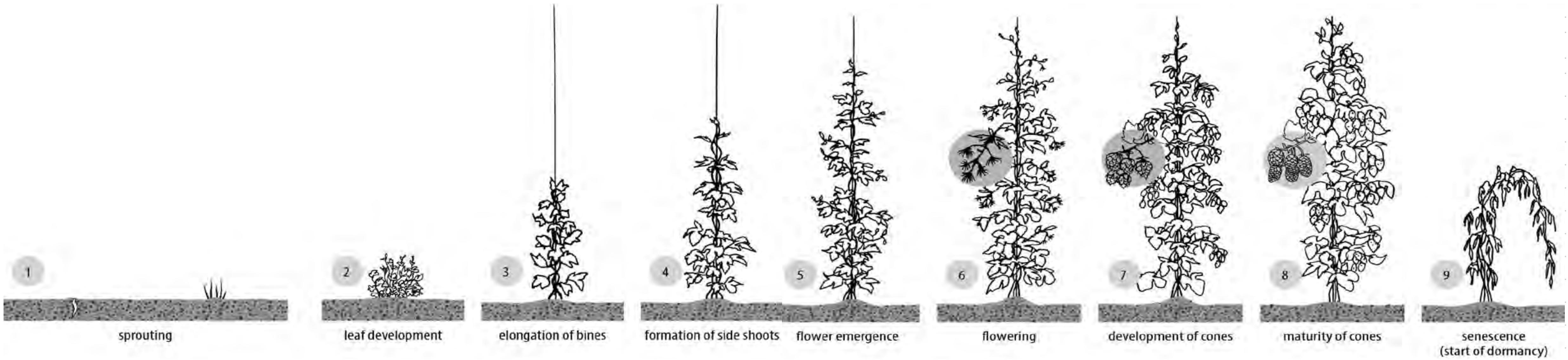


Reproductive Growth- End of July

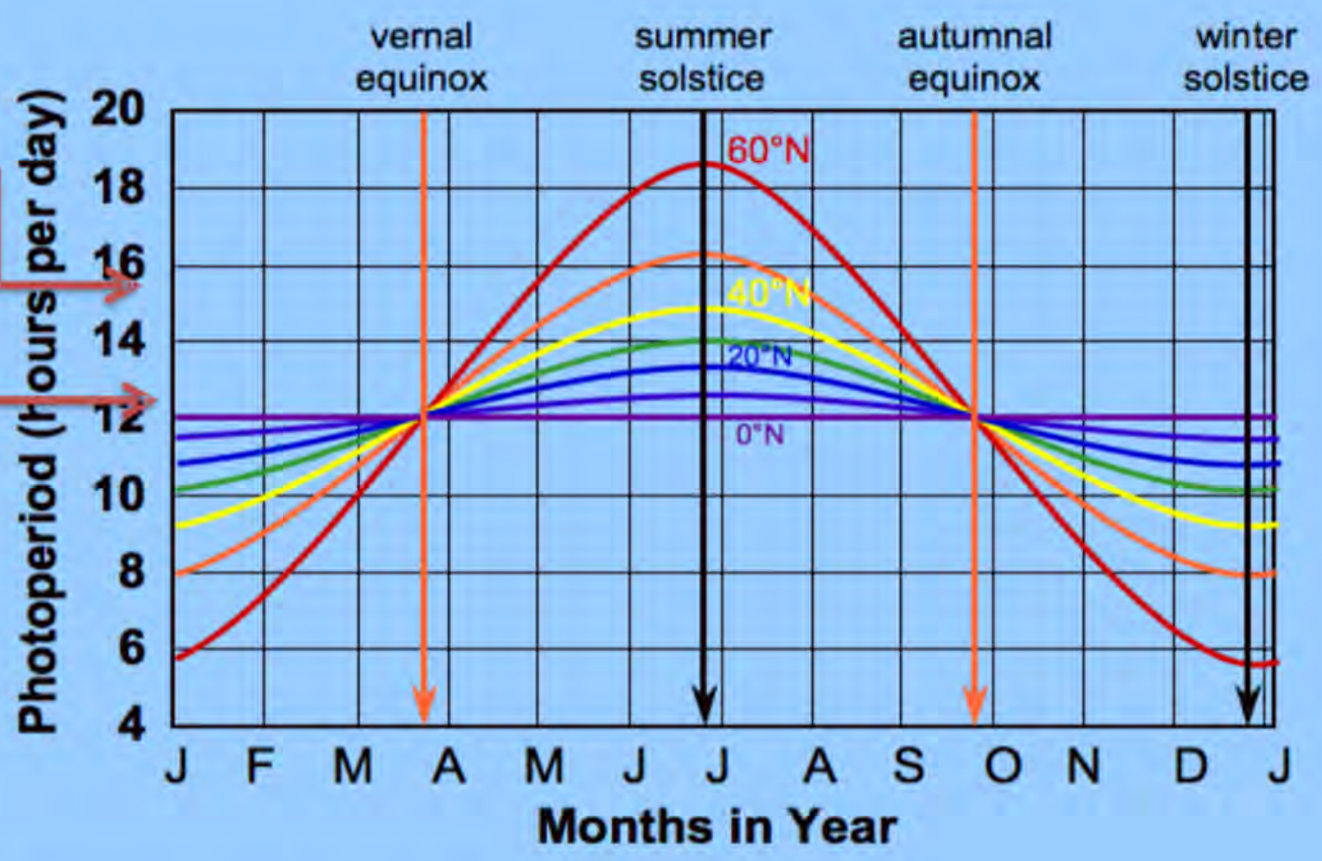
- Dormancy
- Spring regrowth
- Vegetative growth
- **Reproductive growth**
- Preparation for dormancy

- Plant shifts energy into cone production
- Vegetative production is diminished
- Photosynthetic capacity of the plant is maximized
- When cones mature they can account for ~50% of the total above ground dry matter

Photoperiod Sensitivity (why location matters)

Floral Initiation

Plant growth begins



Traverse City, MI: 44.77 degrees N

In shorter day areas (lower latitudes) flowering occurs as soon as the node requirement is met = yield is not maximized

In longer day areas = vegetative growth is maximized prior to shortening days of mid-late summer

Too far North- Spring delayed too long

The switch from vegetative to reproductive development (floral initiation) is dependent on: 1) Cultivar, 2) Number of nodes (part of stem where leaf grows), 3) Day length (15 hrs of light)

How would lower latitudes affect flowering?

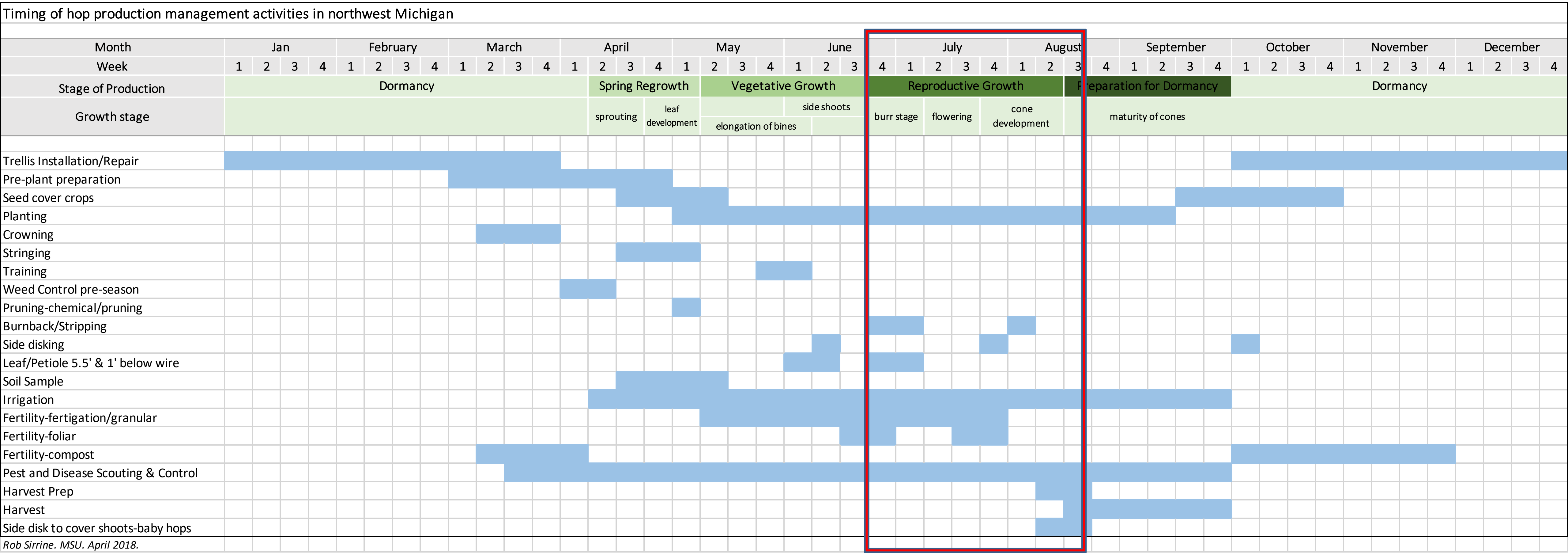
- Bhat et al. 1978. in Kashmir (~34 latitude), early trained hops had two flushes of flowers; one before the longest day, one after.
- At this latitude, the daylength when the plants began flowering was short enough to initiate flowering.
- But then increasing daylengths suppressed the flowering.
- Flowering then resumed as the daylength shortened later in the season.
- Importance of growing cultivars with daylength requirements well suited to locality (IHGC 1983).

Reproductive Growth

In the field

- Cannot increase cone numbers
- Focus on: plant health to maximize cone weight and resin/oil content
- Water management
- Nutrient management

- Dormancy
- Spring regrowth
- Vegetative growth
- **Reproductive growth**
- Preparation for dormancy




I guess you could say things are getting pretty serious

Preparation for dormancy

Physiological ripening

- Period starts at the time of technical maturity of the cones and ends with the phase of physiologically maturity
- Cones become brown, bracts turn outward and are easily dislodged, quality and quantity of alpha, beta acids, and oils, generally decreases

Physiological ripening

H. Matsui et al./Food Chemistry 202 (2016) 15–22

Appearance of hop, according to its harvest date. Raw hop cones (A), ground hop cones (B).

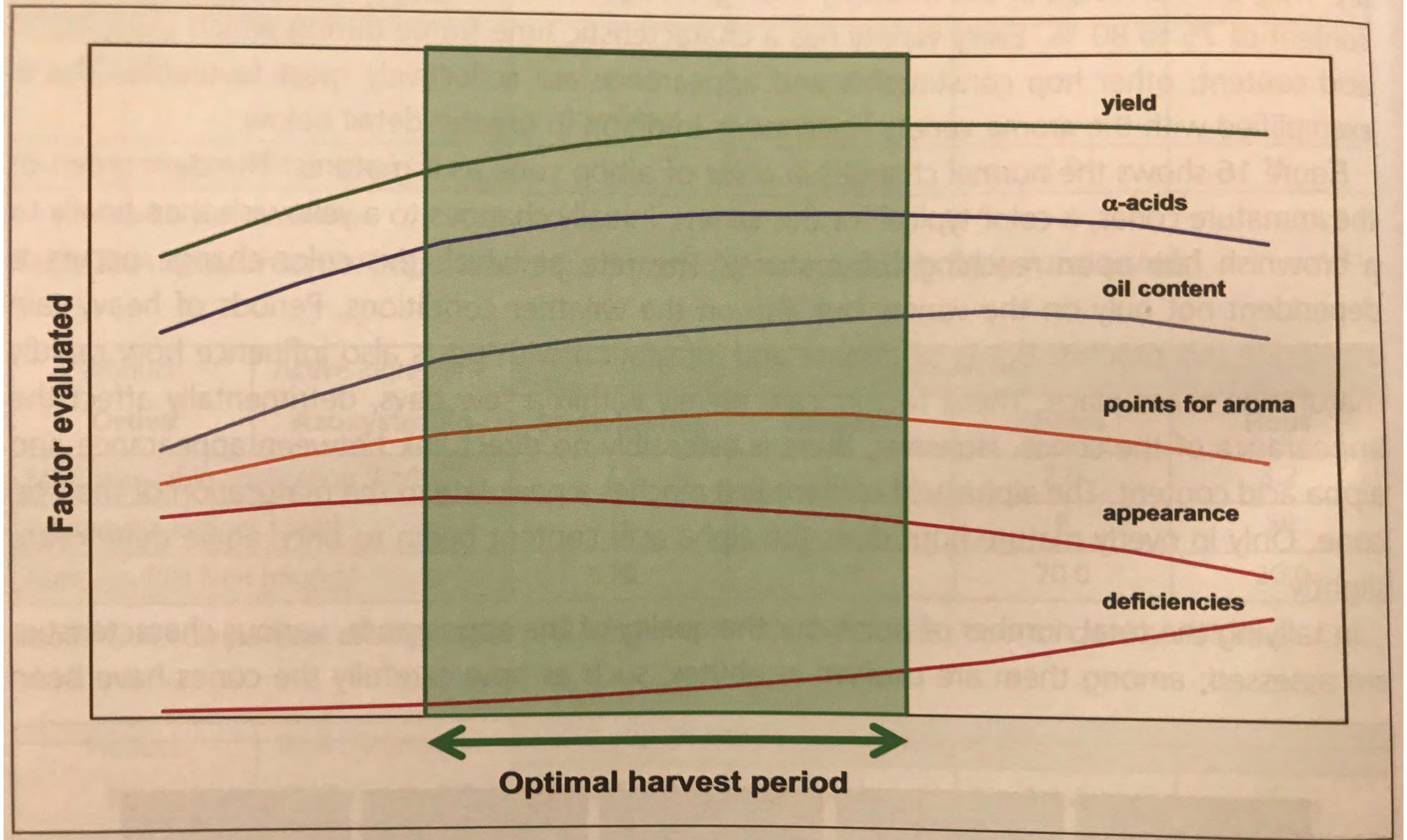


Figure 17: Schematic diagram of the most critical factors affecting yield and quality at various times over the course of the harvest

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Harvest Timing

- Hops are harvested upon reaching the "technical ripeness" (highest brewing value), not at full or "physiological" maturity.
- **Each variety has its own specific, genetically determined optimal time of harvest. Varies by the weather, location, biological window, and the cutting time.**

Harvest time crucially affects:

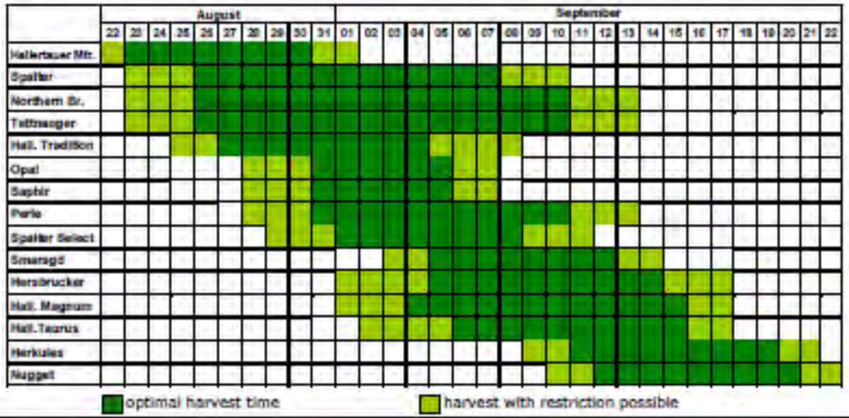
- α-acid contents
- yield
- external quality (color and shine, infection with diseases and pests, shattering)
- aroma (aroma intensity, oil content and composition)
- vigor and vitality of the plant (in the next season)

↓

Economic interest of hop growers, traders and brewers

Results from harvest time studies

- 5 – 8 harvest times (2 dates / week), 4 replications with 20 bines each
- 3- 4-year-trials (climate, health and vitality)
- data for yield, α-acid contents, aroma, external quality, shortcomings assessed

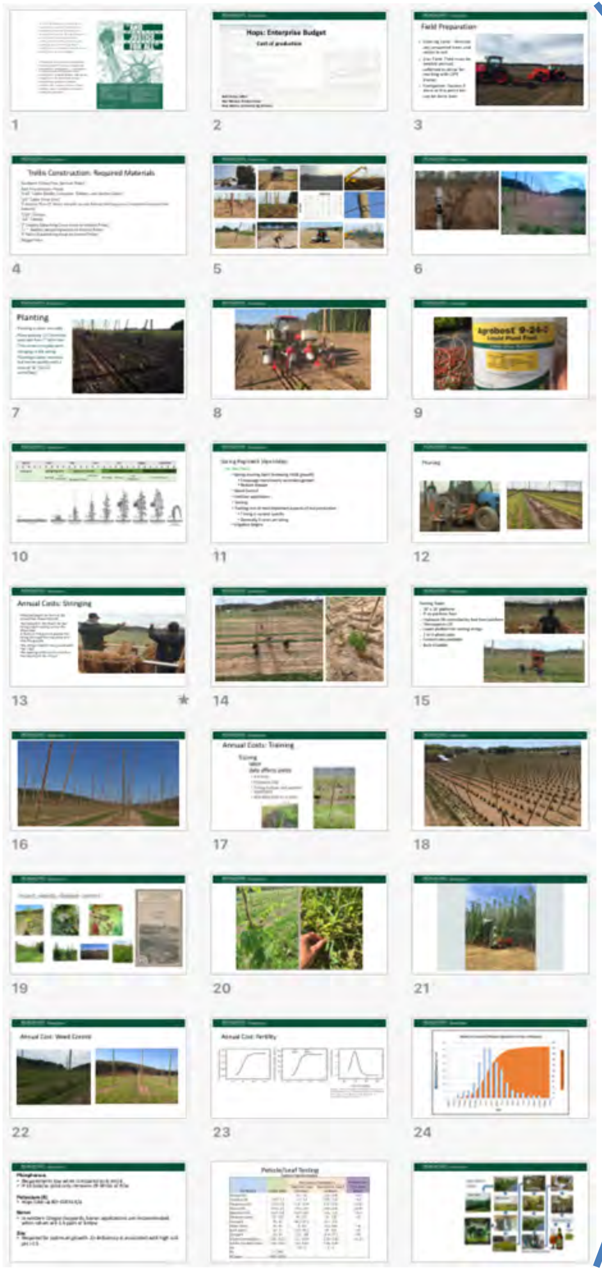


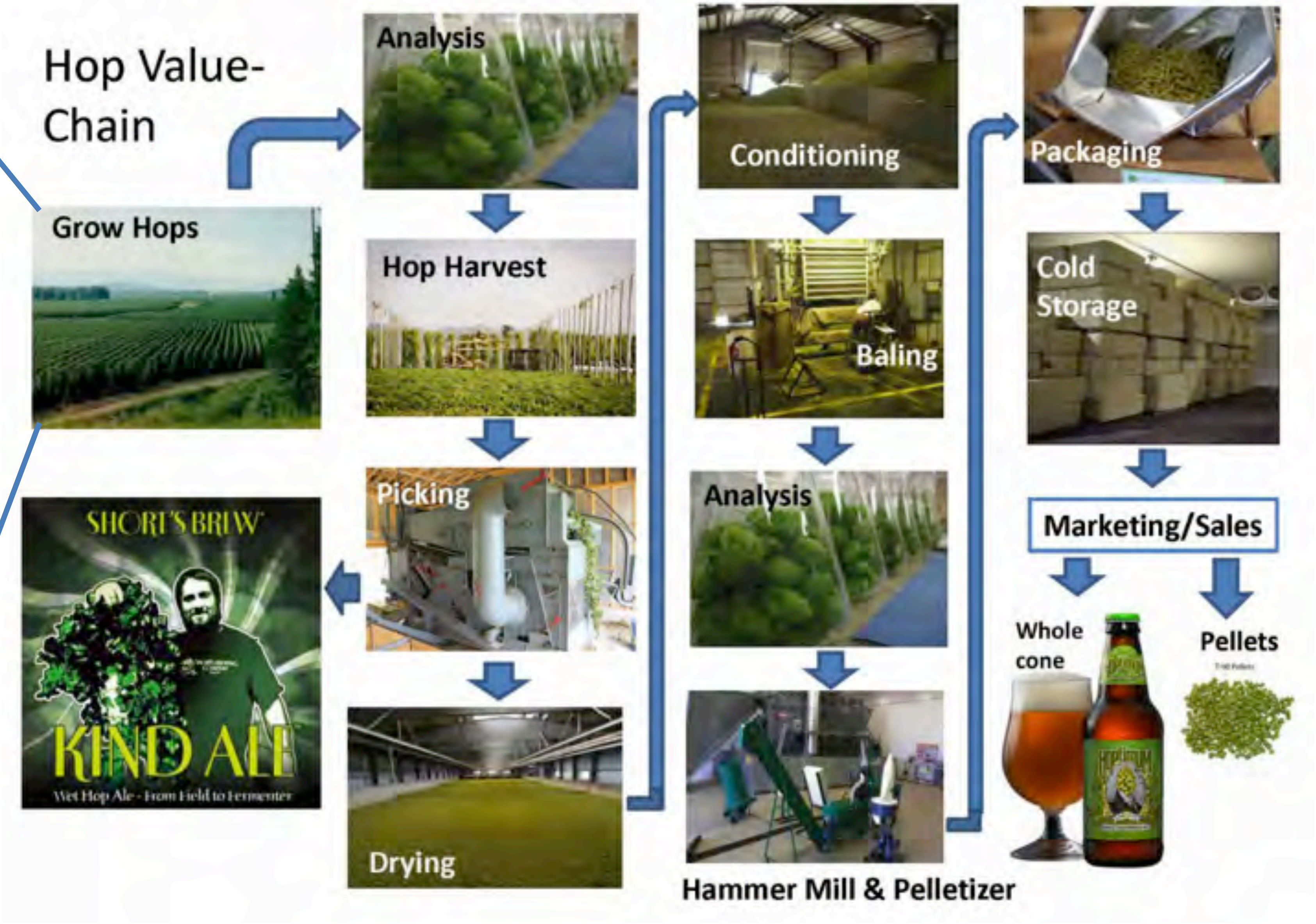
Lutz et al. 2009. The Right Time to Harvest Optimal Yield and Quality. Bav. State Research Center for Agriculture. Institute for Crop Science and Plant Breeding Hop Research Center Hüll

Removing the guesswork

Harvest Package $50

- Combining Brewing Values (alpha acids, beta acids, and hop storage index (H.S.I.)) and Dry Matter analysis, the Harvest Package is designed with hop farmers in mind.
- Results provide growers with content and characteristics of their hops and/or fields and can be utilized on an annual basis to establish trends within a given hop variety or lot location.
- Prior to harvest, these results specifically equip growers with the necessary information to plan peak harvest windows and make informed decisions regarding alpha content, hop cone maturity and overall hop quality.
- Require a 200g sample and a minimum 1 day turnaround.




Hop Value-Chain
Grow Hops
Analysis
Hop Harvest
Picking
Drying
Conditioning
Baling
Analysis
Hammer Mill & Pelletizer
Packaging
Cold Storage
Marketing/Sales
Whole cone
Pellets
SHORT'S BREW
KIND ALE
Wet Hop Ale - From Field to Fermenter

By Hand


LA2255
KUBOTA

Transport to the Picker

Degradation potential

- Distance?
- Humidity level?
- Time of harvest (early a.m. or noon)?
- Temperature at harvest?
- Cost

In terms of the drying process picked hop cones can be regarded as a living organism whose basic life processes, particularly respiration, are continuing. They first react to being removed from the plant by a higher intensity of respiration. Rybacek, 1991.

Picking

Considerations

- •Acreage
- •Speed (bines/hour)
- •Drying capacity
- •Pelletizing capacity
- •Storage
- •$$$
- •Varieties
- •Scheduling

Hop Picking Capacity

Picker	bines/hour	total
• 140	140	15a
• 170	170	20a
• 220/230	220	32a
• WHE 513	500	80-100a
• Danhauer	1.5 acres	a lot

513 video

Dormancy (September-November)

Decaying bines

- Period starts with physiological ripening of cones and ends with complete decay of bines
- Above ground plant parts perish, process starts with top of bine and upper shoots and continues down
- Shoots and fine roots die
- Storage roots thicken and accumulate starch
- Large resting buds develop
- Transfer of reserves to the underground organs ends

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MI LOCAL
HOPS
ABOUT
TEAM
HOP VARIETIES
CONTACT
VIDEOS

Drying

The drying process is affected by many factors and lasts 5-8 h or more.

It is regarded as the most important operation in the harvesting process.

1. air velocity
2. air moisture content
3. bed depth
4. air temperature

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ATEF ONE
ATEF.ONE GmbH
09-09-2017 15:17:01
Windregelung ausschalten
Vorgaben
Auto. Ab-schaltung
Nacht-zyklus
Das Gebläse: Einschalten
Brenner: Einschalten
Leistungs-rückmeldung: 1: 0 kW
2: 0 kW
Leistungs-rückmeldung: 1: 0.0 kW
2: 0.0 kW
Phasen
Gebläse Leistung: 70 %
Dauer: 5 min
Gebläse Leistung: 80 %
nach Dauer
20 min
Gebläse Leist.: 50 %
v max.: 0.50 m/s
Bis rF <
65 % rF
Gebläse Leist.: 40 %
v Optimal: 0.38 m/s
Während der Befüllung
Gebläse Leist.: 50 %
Brenner Temp.: °C
Wind-regelung neu starten
25.5 °C
11.9 ΔrF%
62.6 %
0.000 m/s
0 ml/qm/min
Ø afm
-0.65
Rauchgas
57.6 °C
61.8 °C
37.9 °C
29.5 °C
14.2 °C
16.6 °C
17.2 °C
74.4 %
Zeit ab Phas
116 min.
Phase: Homogenisieren
Restlaufzeit: 180 min.

Conditioning

Considerations

- Humidity- (In 2 hours you could go from 9% to 13% moisture)
- Throughput and timing
- Space requirements
- Food safety?

- The hops are left in these heaps for 12 hours in a staged process known as “conditioning”.
- The heaps are re-piled for a further 12 hours across the floor in which time the moisture level continues to equilibrate to ensure consistency prior to baling.
- Target moisture level for our hops is around 9.5 % (+/- 1 %) which requires a high level of patience and skill to achieve.

Baling

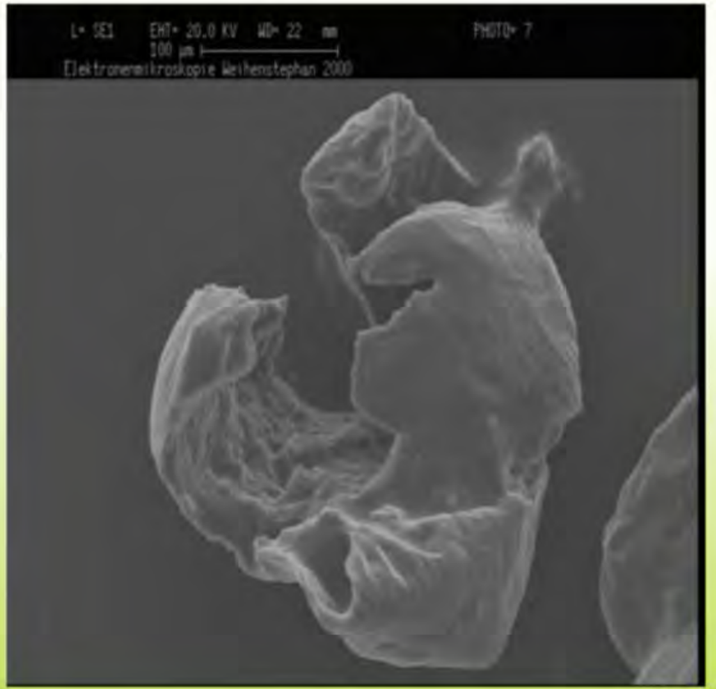
Considerations

- Timing
- Quantity of hops
- Size
- $$ baler
- Storage
- Transport

"Whole leaf hops are voluminous, but turning them into a bale makes them more compact and stackable, and overall easier to store. It also cuts down on oxidation, which affects brewing quality."

Baling

Lupulin Glands from Bales

139 kg/m^3	185 kg/m^3
	

HVG

Processing (Pelletizing)

Pellets: Preferred storage method.

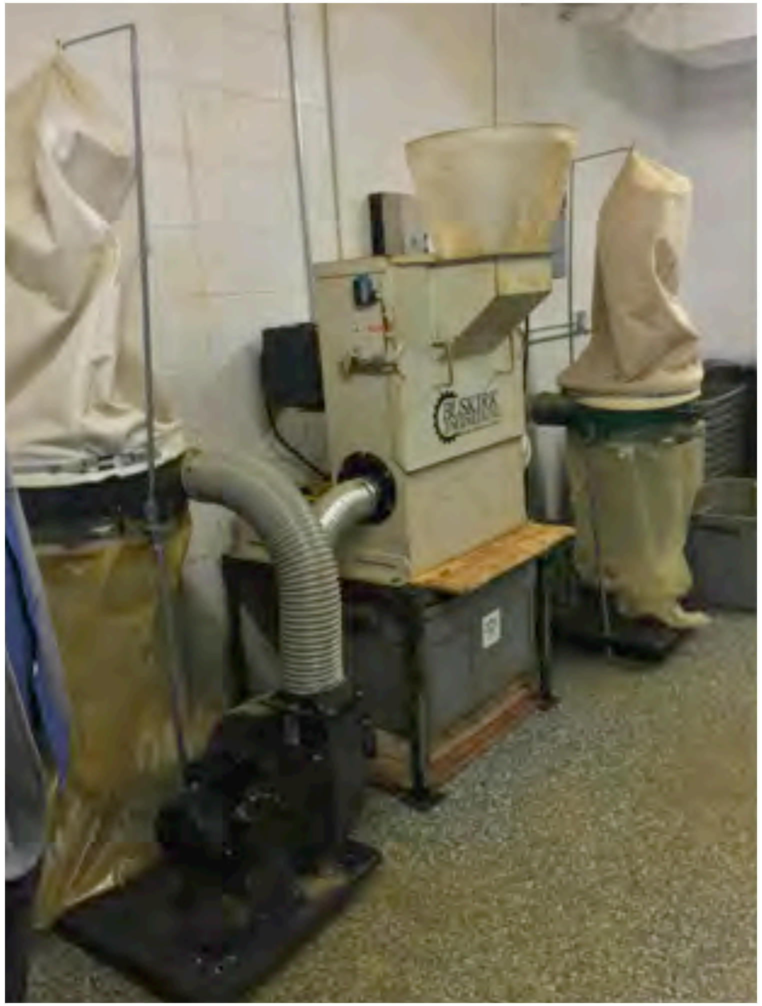
Considerations

- Temperature
- Time
- Machine type
- Machine $
- Facility

Pelletizing Lesson: Throughput efficiency

MHA

Buskirk ~75 lbs/hour



New Buskirk
600 lbs/hour

Lawson Mills
800-1000 lbs/hour
Max 50 C/ 120 F
Cool Die Press
$50,000+

Bottleneck is bagging & packaging


MI LOCAL
2000-2500 lbs./hr
$0.35-.40/lb.
NISSAN

Packaging and Storage

Considerations

- Photosensitivity
- Oxygen
- Package size and quality
- Cold storage
- Hops are photosensitive and, therefore, long exposure to light changes their biochemical structure as is shown by a typical red-brown colour, which is commercially undesirable.

Barth-Haas Group

Packaging

- Pellets are packed in laminated foils with an aluminum layer as a barrier against diffusion of oxygen
- Sealed under inert gas and/or vacuum packed
- Foil material used meets all food industry packaging regulations
- Residual oxygen content in the foil packs is <2% by volume
- Pack sizes are available from 1kg to 500 kg

Storage and Best-by Recommendation

- Type 90 Pellets should be stored cool at 0 – 5°C (32 - 41°F), best used within 3 yrs
- If stored at –20°C (-4 °F) , pellets should be used within 5 years.
- Foils, once opened, should be used within a few days to avoid deterioration of bitter acids and essential oils.

Cold Storage

- For AB-This freezer keeps the hops stored within at a constant 18-26 degrees Fahrenheit at a 70% relative humidity.

http://www.fwwarehousing.com/divisions/5/cold-storage.html

Global Cold Chain Alliance

- Optimum storage temp. is 24° to 28° F
- Relative humidity 70-85%
- Sufficient space should be allowed around the bales for ventilation so any heat generated in the bales may be dissipated

http://www.gcaa.org

Hop Analysis Services

Harvest Package $50

- Combining Brewing Values and Dry Matter analysis

Hop Profile Package $130

- Combining Brewing Values, Oil Content and Volatile Oil Profile analyses, this package is designed to help customers determine the alpha acids, beta acids, hop storage index and oil content of their hops.

Brewing Values $35

- Alpha acids, beta acids, and hop storage index (H.S.I.) values

Dry Matters $20

- Dry matter analysis provides growers with the necessary information to forecast peak harvest windows based on hop cone maturity

Oil Content $20

- Provides a value for the volume of oil in a hop sample

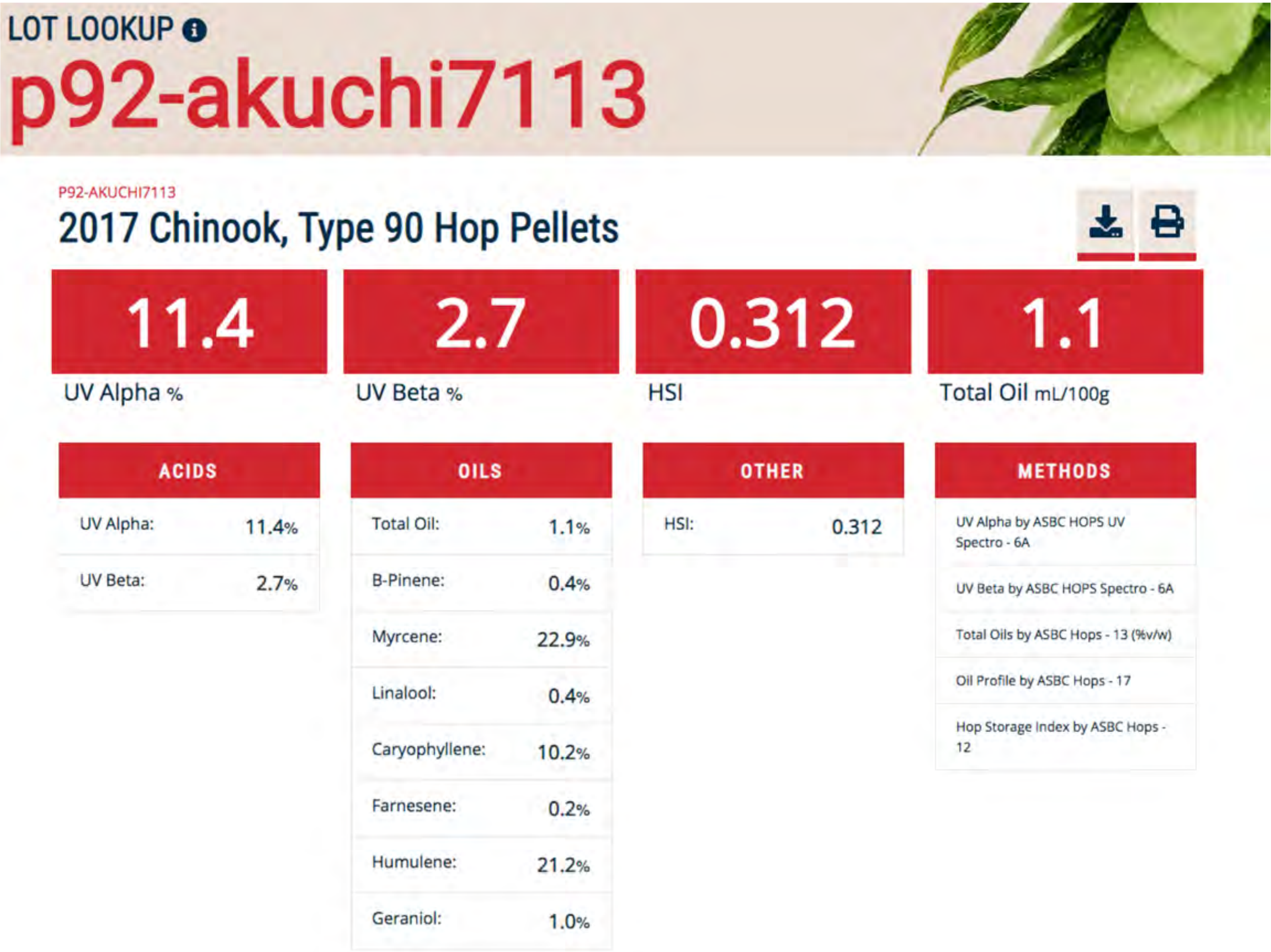
Volatile Oil Profile $100

- Volatile Oil Profile provides a specific value for the most important oil compounds

Food Safety (GHP)

What information will a brewer want to know?

- Lot number (variety/location)
- Lot weight of bales
- Seed, stem, leaf
- Weight of finished pellets (% loss)
- AA% (of bales AND pellets)
- BA% (of bales AND pellets)
- Moisture (of bales AND pellets)
- HSI (of bales AND pellets)
- Pellet die and screen size used
- Pellet density (lbs. / cubic foot)
- Oxygen content
- Pellet temperature
- Essential oils?



MEMBER LOGIN BECOME A MEMBER

USA HOPS
HOP GROWERS OF AMERICA

HOP ENTHUSIAST

HOP FINDER

NEWS & MEDIA

GROWER TOOLS

RESEARCH & TECHNICAL

CONVENTION

INFO HUB

Cost of Production | Small Grower Council | Educational | Clean Plants | Industry Standards | Food Safety | Plant Protection | Supplier Directory

Newly updated versions released November 2016! The following Hop Enterprise Budgets have been developed by Michigan State University and the University of Vermont!

5 Acre Hop Enterprise Budget

10 Acre Hop Enterprise Budget

20 Acre Hop Enterprise Budget

The *"2015 Estimated Cost of Establishing and Producing Hops in the Pacific Northwest"* published by Washington State University, is available below. This version is marked "draft", however, it is the final version.

2015 Hop Enterprise Budget

2015 PNW Hop Production Cost Study Workbook

Hops: Enterprise Budget

https://www.usahops.org/

Rob Sirrine, MSU

Dan Wiesen, Empire Hops

Alex Adams, Harmony Ag Services

Take Home Messages: Growing

- Buy machinery that will increase your efficiency
- Don't be afraid to lease or rent equipment
- It costs at least $8000/yr to own a tractor
- It costs at least $3000/yr to own a sprayer
- Hire labor when necessary
  - twining, training, harvest
- Timing is crucial-don't get behind
- Be realistic what you want to receive for your hops
- Make your budget fit the income side of the equation
- Never skimp on spraying or fertilizing. You need to feed the beast!
- Be prepared to pull out and put in new cultivars maybe every 7 year

Initial Challenges

- Necessary to invest in trellis, plants, and annual growing expenses + harvesting and processing equipment
- Usually 1.5 year lag time between planting and harvesting first crop
- Expense of 2 growing seasons until first harvest
- Must also pay harvest and processing costs on top of growing
- At least 2 year lag time until you get paid!

Continuous Challenges

- Don't overlook sales (seems obvious).
  - Make sure you sell everything you grow
  - Can't leave 10—15% unsold, that is your profit margin.
  - Make sure you get paid Don't be afraid to idle varieties if there is an oversupply
- Be aware of market trends and be current with your variety mix
- Don't be afraid to tear out and replace varieties
  - In fact, add the cost to your business model
- Don't expect brewers to contract immediately, they need to gain confidence in your product

Contract Considerations

- 20% down, 10% for next 8 months
- Brewer cannot take more than they have paid for
- Try and get brewers to take all of their hops prior to next harvest
- Don’t let brewers contract too much. You will get stuck with the hops.
- Better to have multiple customers than 1 big customer
- Storage costs are a big factor- do not ignore them

- The majority of breweries who are thinking of distributing or started distributing most likely have contracts or a consistent provider.
- Follow that brewery on social media and see if their giving their ingredient suppliers love.
- Read every page on their website and take notes.
- There are opportunities there but your product must be consistent year to year.
- Always deliver your product ahead of schedule. Brewery schedules change all the time, don’t let your hops hold up beer production

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231-256-9888

USDA NIFA
United States Department of Agriculture
National Institute of Food and Agriculture

North Central IPM Center

HOP GROWERS OF MICHIGAN EST. 2014

MICHIGAN THE GREAT BEER STATE
JULY IS MI CRAFT BEER MONTH

Thanks!

Rob Sirrine
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That's all Folks!