Chilling Requirements and Chemical Budbreak Induction for Successful Blackberry Production in Florida

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Climatic challenges

- Adapted to **temperate climates** with cool or cold winters (top 3 blackberry producing states: 1) Oregon, 2) California, 3) Georgia
- **Chilling requirements** to break dormancy and trigger uniform budbreak (300–900 hours below 45°F for most commercial cultivars)
- **Fruit disorders** caused by Florida's environmental conditions during the peak harvest (May–June)
- High temperature (fruit temp >73°F) → **Red drupelet reversion (or red drupelet disorder)**
- High light intensity → **White drupelet disorder**
- High rainfall → **Fruit softening and leakage**

Chilling requirements

Chilling requirements

300–900 hours (<45°F) for most cultivars grown in the US

Short daylength

Chill accumulation

High temperature

1

Endodormancy

- Internal signals inhibit active growth
- Needs chilling to break dormancy

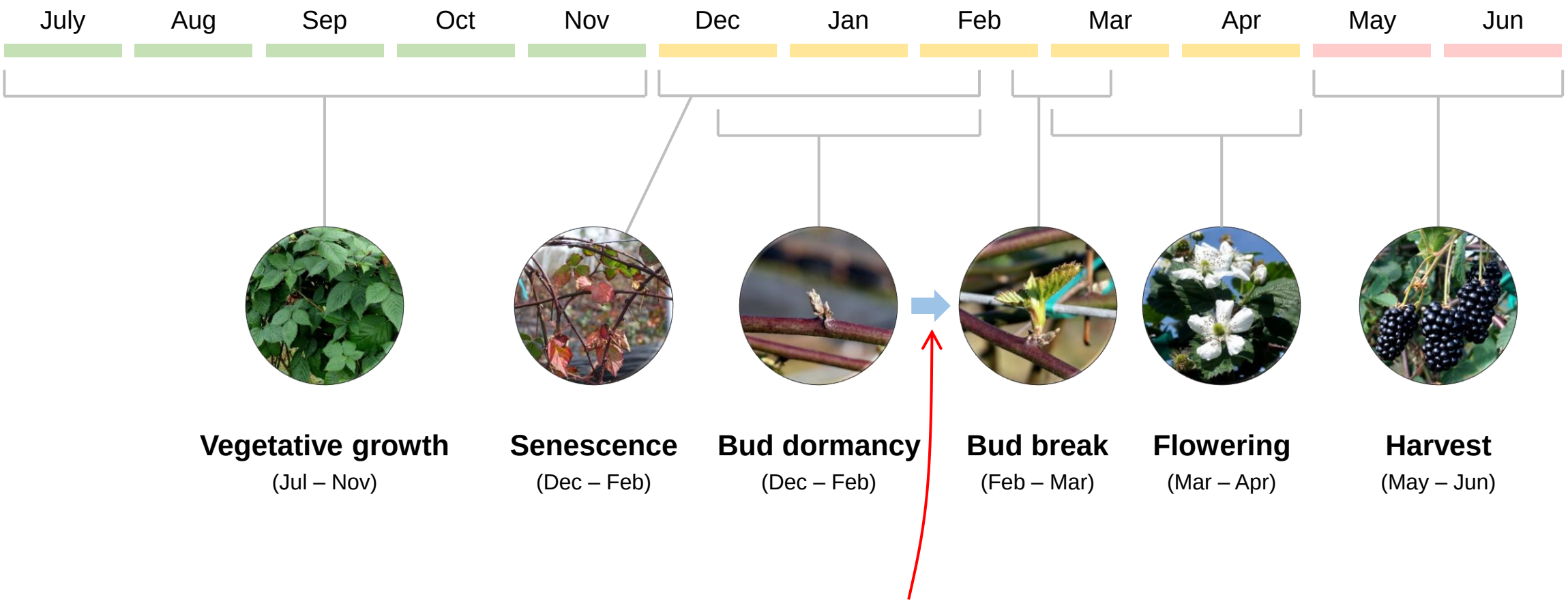
2

Ecodormancy

- External (environmental) factors inhibit growth
- Waiting for favorable conditions

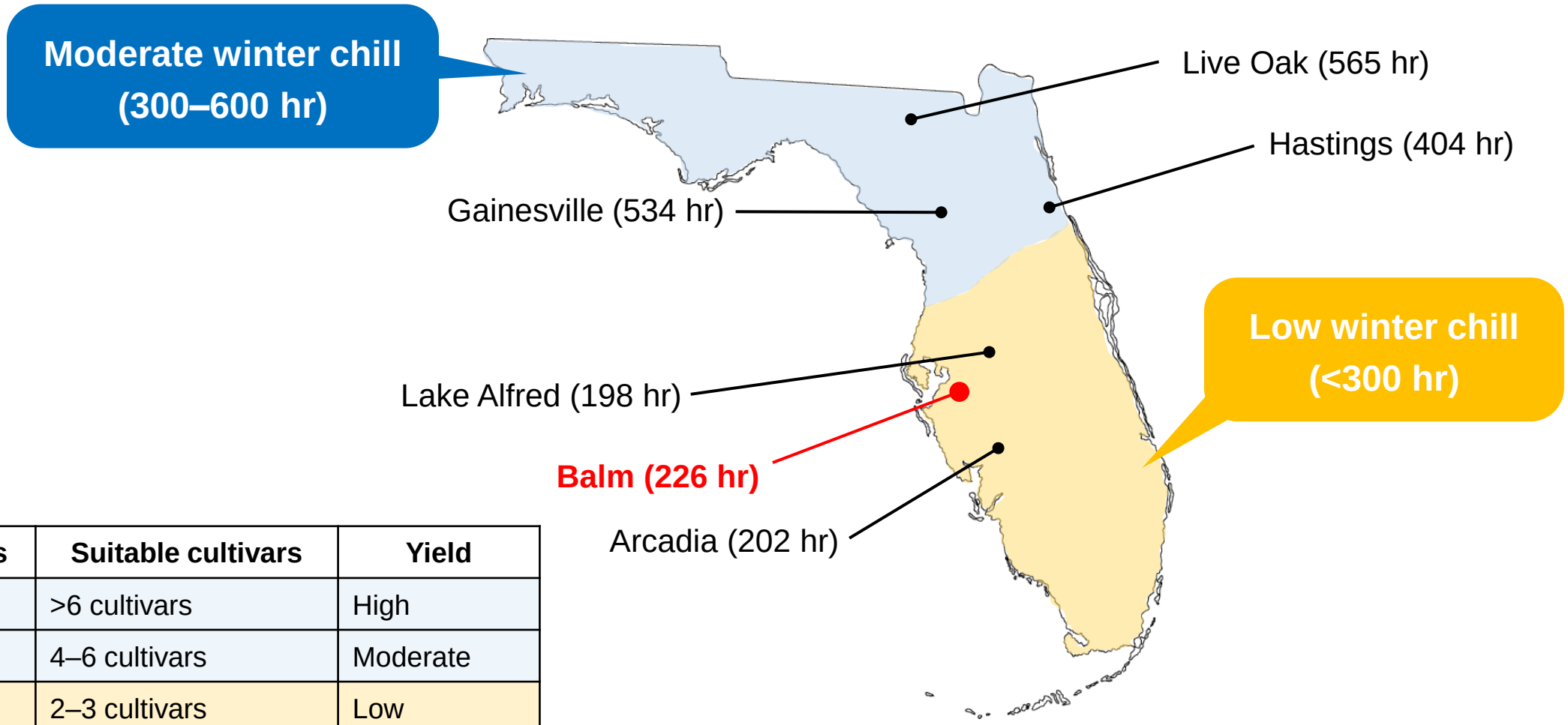
3

Growth cycle in Florida (floricane-type)



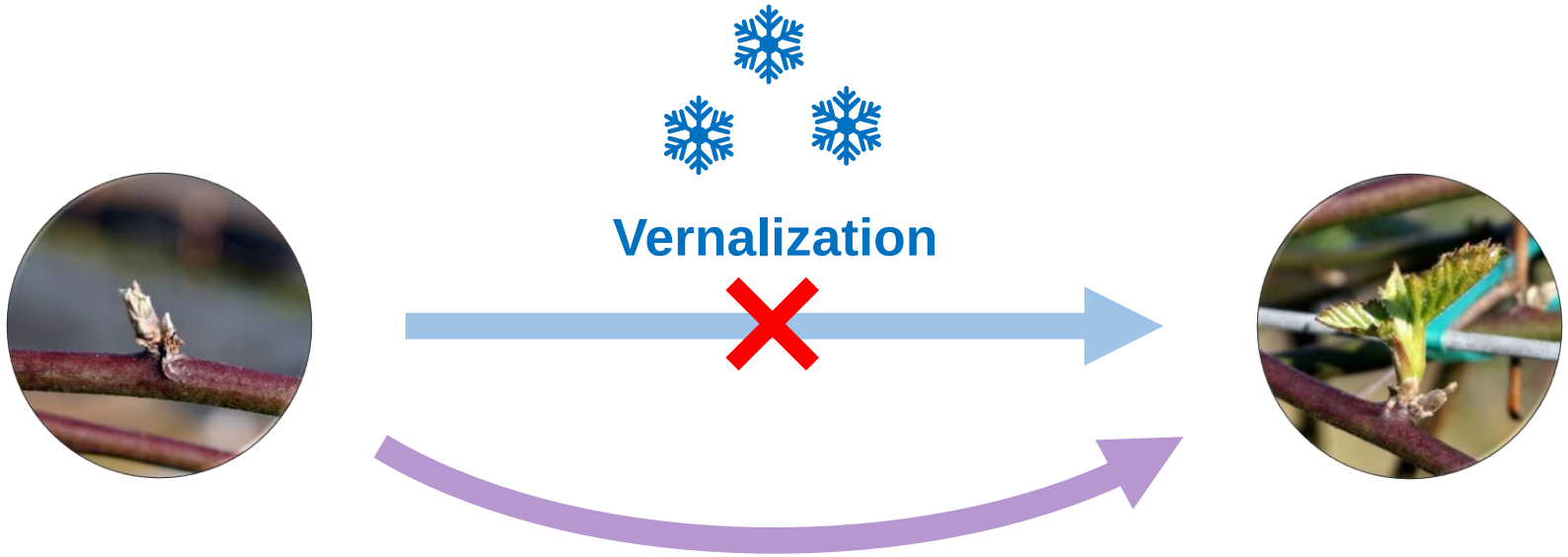
Budbreak requires 300-900 chill hours (<45°F)!!

Winter chill hours in Florida



Chill hours	Suitable cultivars	Yield
>500 hr	>6 cultivars	High
300–500 hr	4–6 cultivars	Moderate
200–300 hr	2–3 cultivars	Low
<200 hr	None	Very low

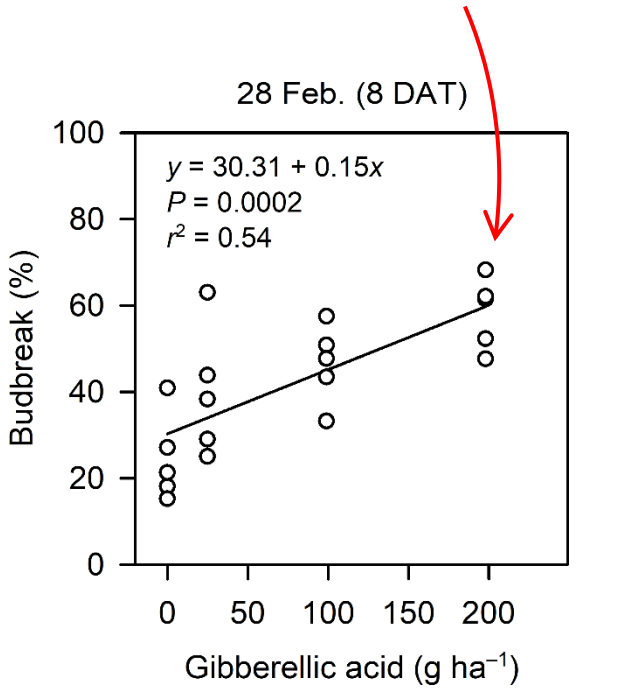
Natural vs. chemical vernalization

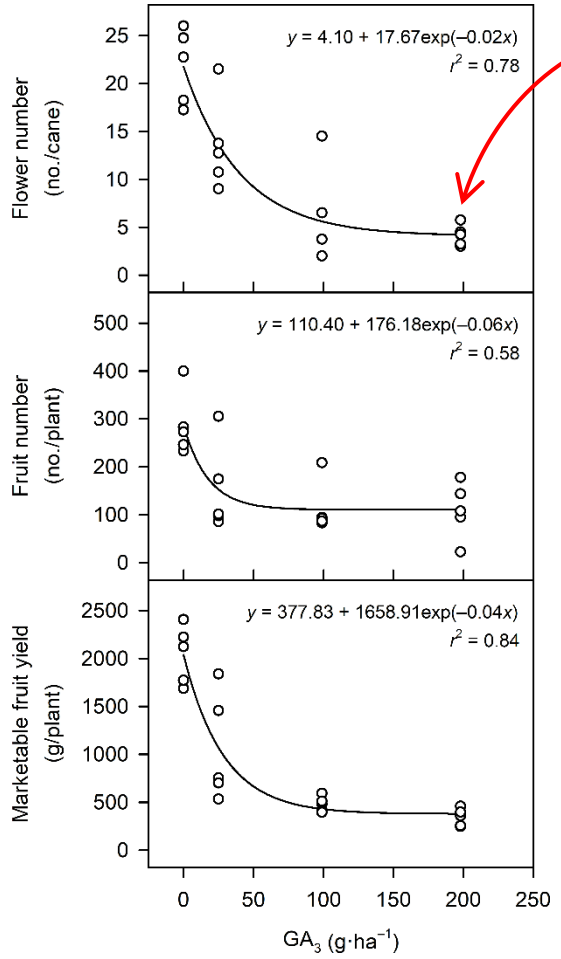


- Plant hormone (gibberellic acid)
- Defoliants

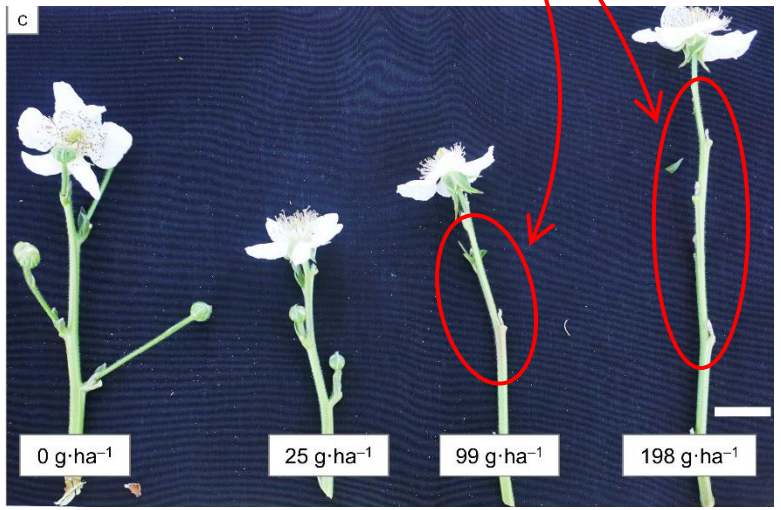
Prod & cons of gibberellic acid

Budbreak ↑



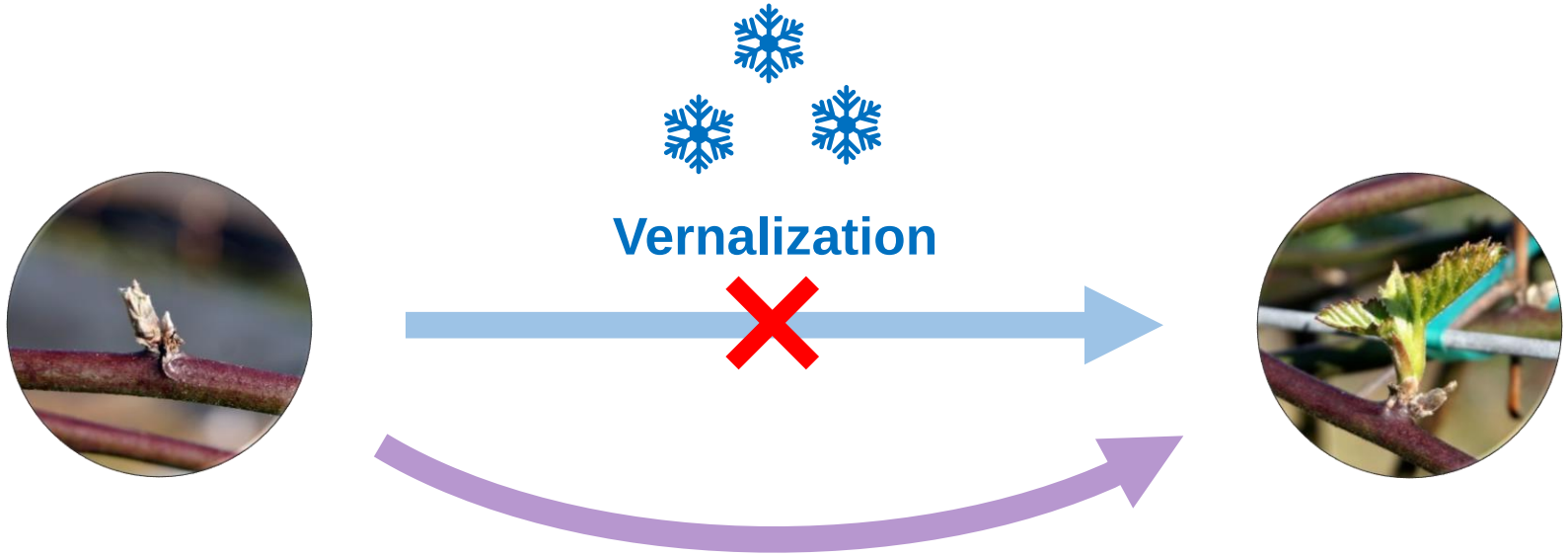


Flower abortion …



Lin, S.-Y. and S. Agehara. 2020. Exogenous gibberellic acid and cytokinin effects on budbreak, flowering, and yield of blackberry grown under subtropical climatic conditions. Hortscience 1:1-8.

Natural vs. chemical vernalization



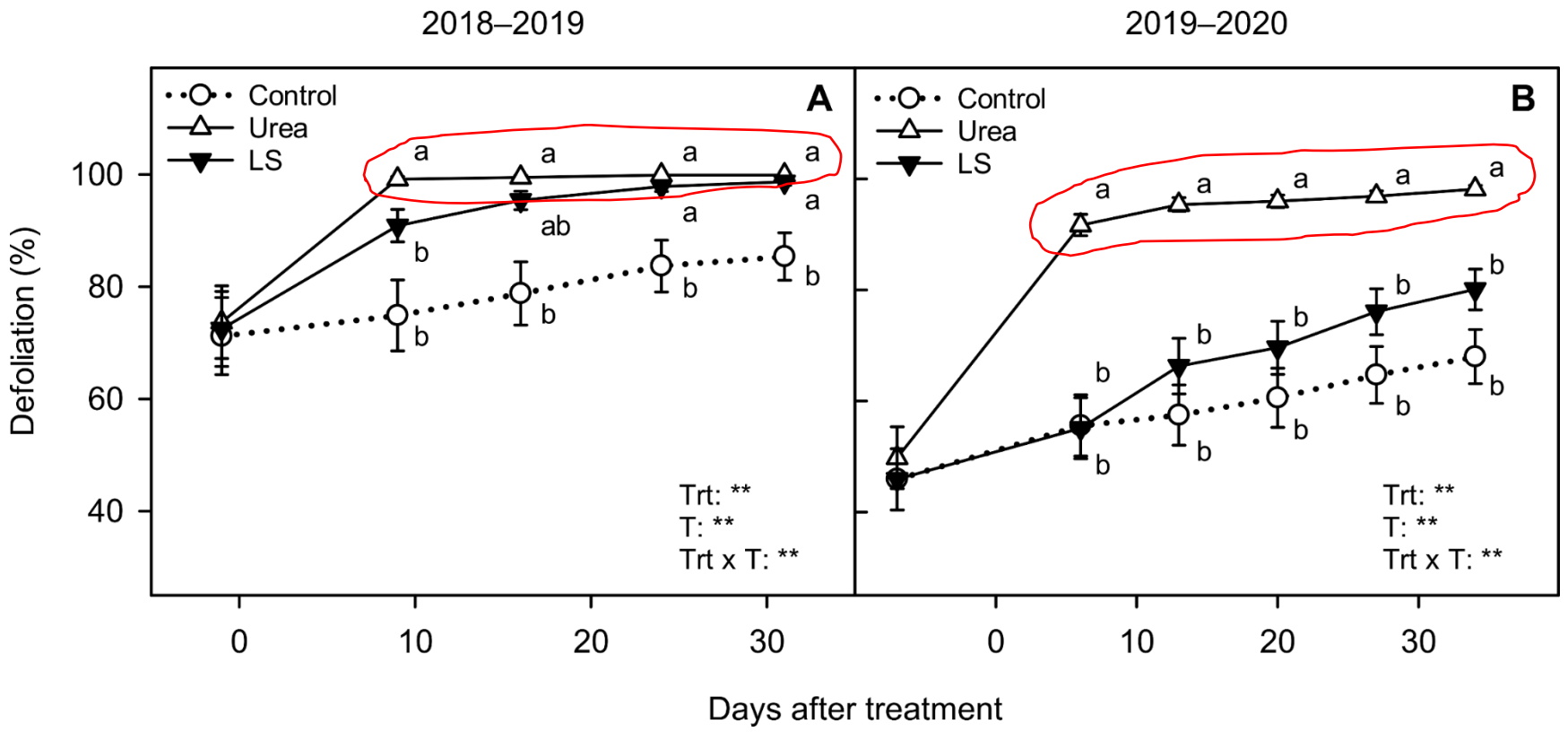
Chemical induction

- ~~Plant hormone (gibberellic acid)~~
- Defoliants

We tested four defoliants:

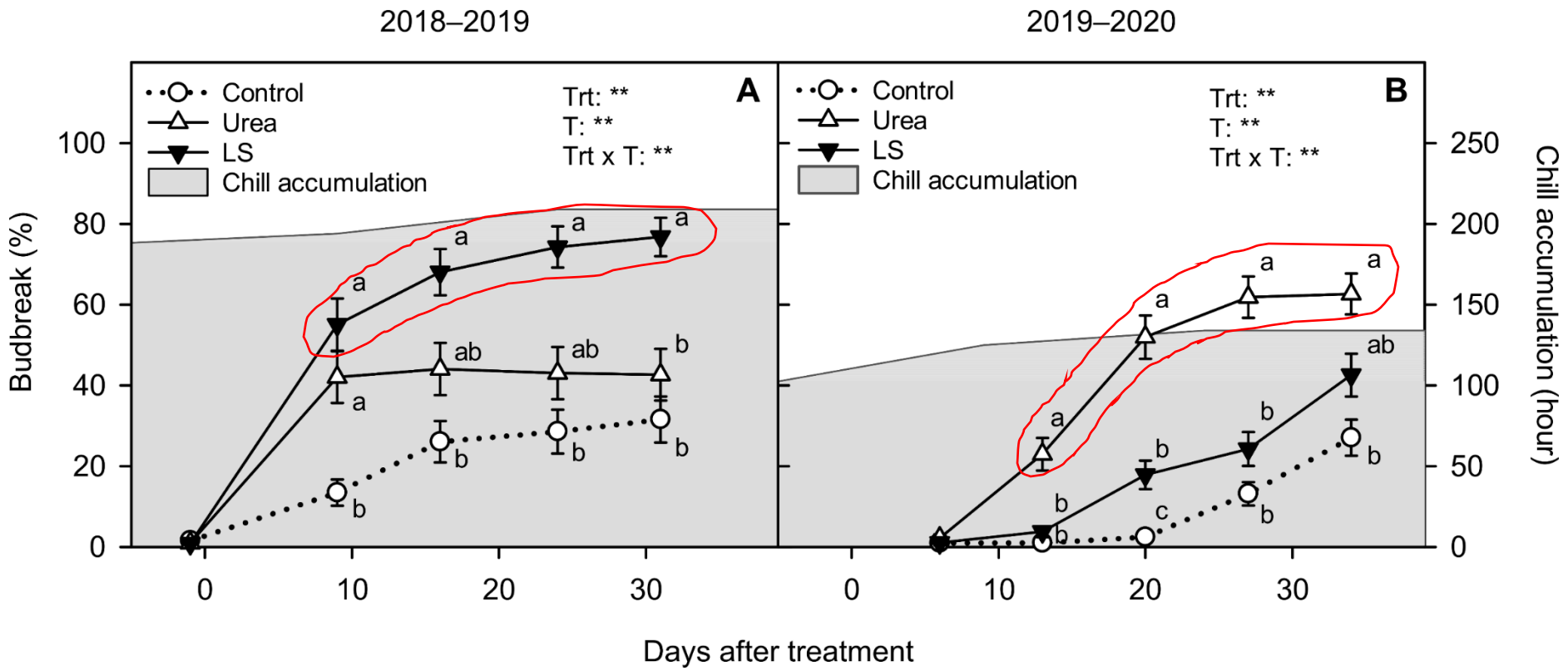
1) urea, 2) zinc sulfate, 3) lime sulfur, 4) potassium thiosulfate

Defoliation (‘Natchez’)



Lin, S.-Y. and S. Agehara. 2021. Foliar application of defoliants after winter chill accumulation changes phytohormone dynamics and improves budbreak in blackberry under subtropical climatic conditions. Plant Growth Regul. 94:171-181. doi:10.1007/s10725-021-00703-x

Budbreak (‘Natchez’)



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Budbreak induction using urea

	Water control	Urea	
13 d			Defoliation ↑
97 d			Fruit set ↑

Yield ('Natchez')

Yield increases

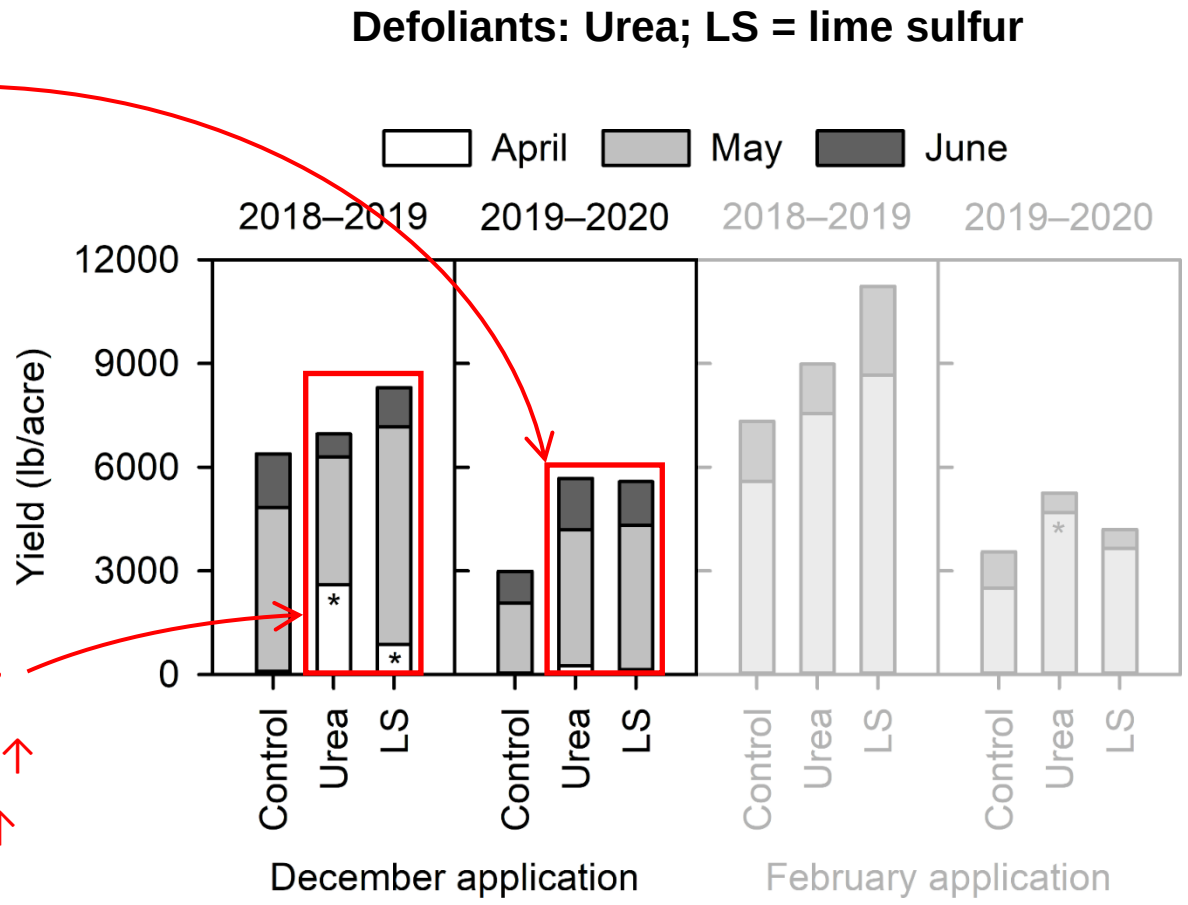
May: 90-101% ↑

Total: 85-87% ↑

Yield increases

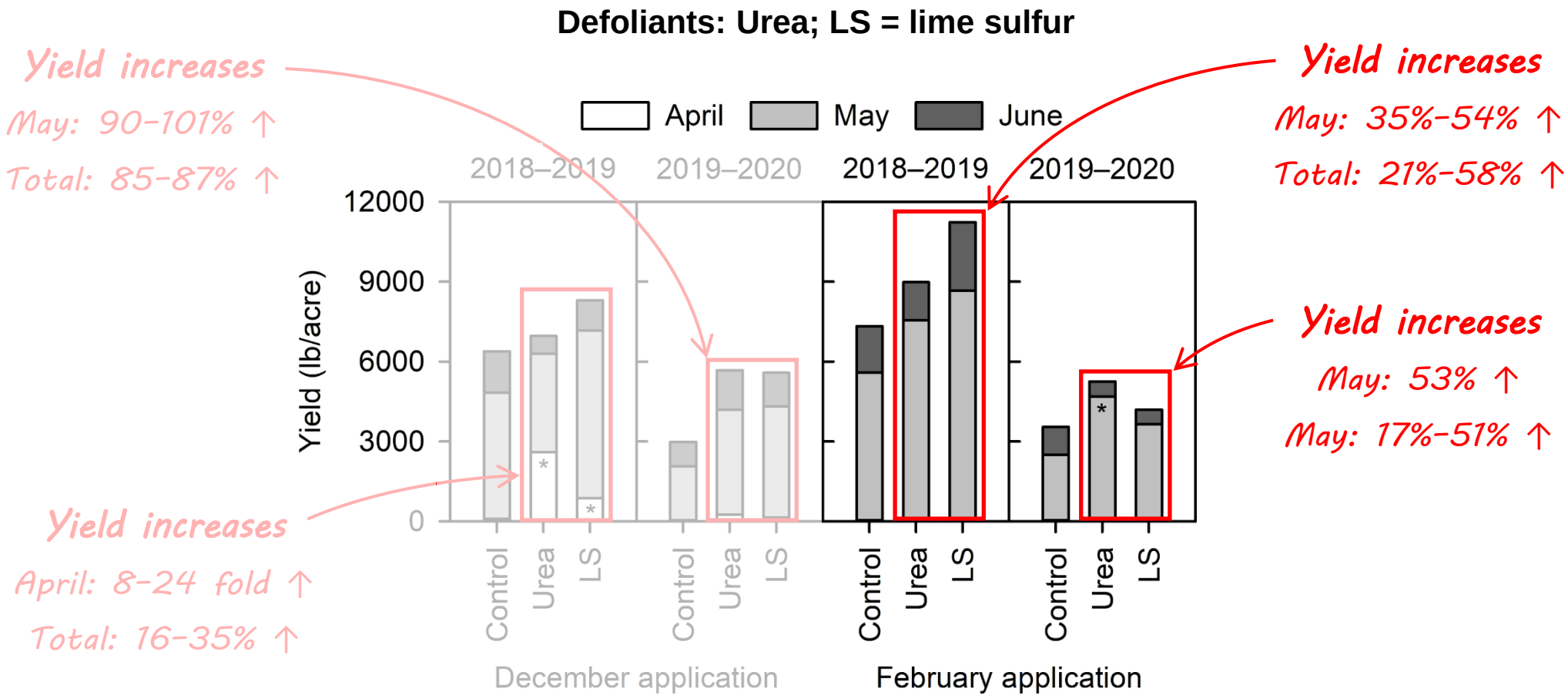
April: 8-24 fold ↑

Total: 16-35% ↑



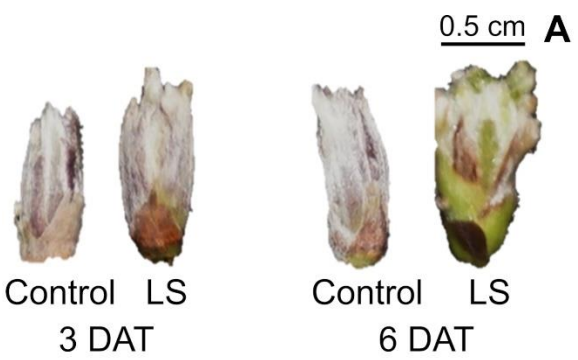
Agehara, S. and S.-Y. Lin. 2021. Chemical budbreak induction methods to increase blackberry yields under inadequate chilling conditions. EDIS HS1352. https://edis.ifas.ufl.edu/hs1419

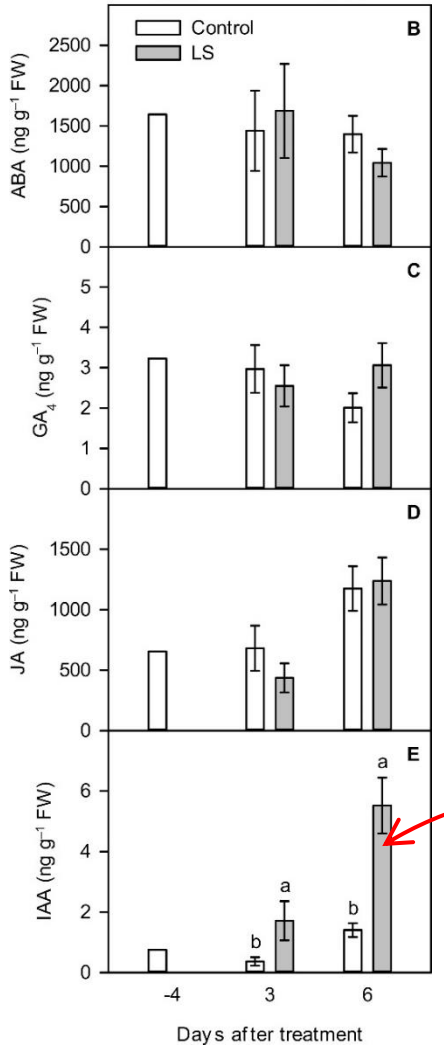
Yield ('Natchez')



Agehara, S. and S.-Y. Lin. 2021. Chemical budbreak induction methods to increase blackberry yields under inadequate chilling conditions. EDIS HS1352. https://edis.ifas.ufl.edu/hs1419

Phytohormone profiling (‘Natchez’)





No difference between control and lime sulfur

Up to 4-fold increases in IAA (auxin) by lime sulfur!

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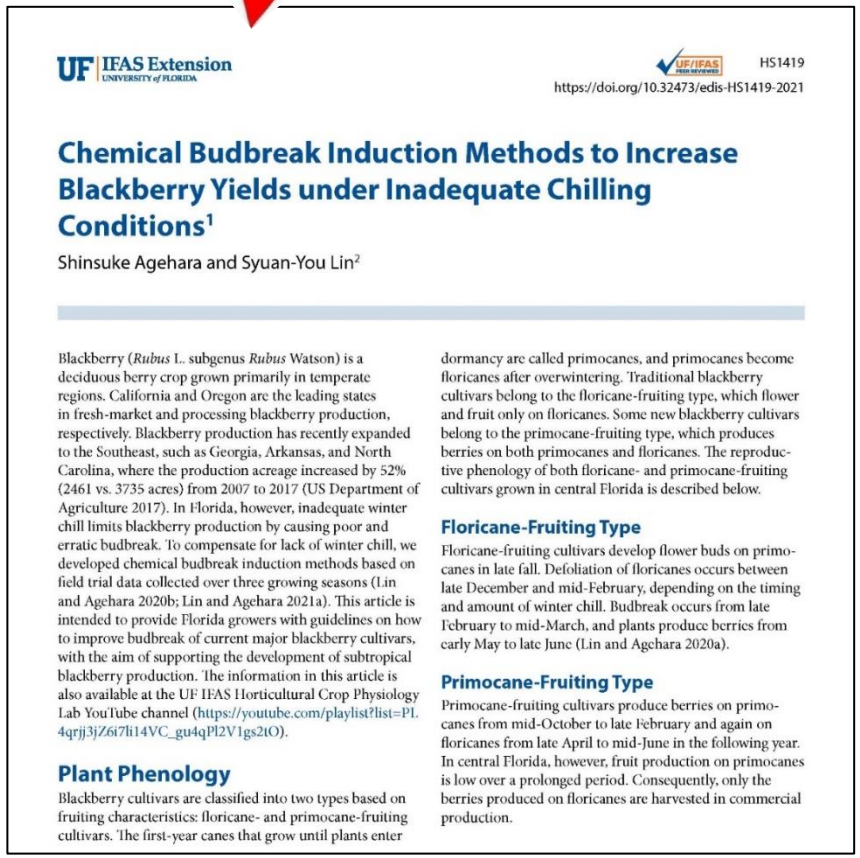
Urea application guide

Location	Chill hours <500 hr
Chemical	Urea (167 lb/acre)
Spray volume	100–200 gal per acre
Surfactant	Agri-Dex (0.5%)
Application timing	Mid-February to early March *Immediately before natural budbreak
Cost	Urea + surfactant: $53/acre + $14/acre = $67/acre Urea: $15.86 per 50-lb bag Agri-Dex: $14 per gallon

https://journals.flvc.org/edis/article/view/128580/131181



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UF/IFAS PEER REVIEWED HS1419

https://doi.org/10.32473/edis-HS1419-2021

Chemical Budbreak Induction Methods to Increase Blackberry Yields under Inadequate Chilling Conditions[1]

Shinsuke Agehara and Syuan-You Lin[2]

Blackberry (*Rubus* L. subgenus *Rubus* Watson) is a deciduous berry crop grown primarily in temperate regions. California and Oregon are the leading states in fresh-market and processing blackberry production, respectively. Blackberry production has recently expanded to the Southeast, such as Georgia, Arkansas, and North Carolina, where the production acreage increased by 52% (2461 vs. 3735 acres) from 2007 to 2017 (US Department of Agriculture 2017). In Florida, however, inadequate winter chill limits blackberry production by causing poor and erratic budbreak. To compensate for lack of winter chill, we developed chemical budbreak induction methods based on field trial data collected over three growing seasons (Lin and Agehara 2020b; Lin and Agehara 2021a). This article is intended to provide Florida growers with guidelines on how to improve budbreak of current major blackberry cultivars, with the aim of supporting the development of subtropical blackberry production. The information in this article is also available at the UF IFAS Horticultural Crop Physiology Lab YouTube channel (https://youtube.com/playlist?list=PL4qrjj3jZ6i7li14VC_gu4qPl2V1gs2tO).

Plant Phenology

Blackberry cultivars are classified into two types based on fruiting characteristics: floricane- and primocane-fruiting cultivars. The first-year canes that grow until plants enter dormancy are called primocanes, and primocanes become floricanes after overwintering. Traditional blackberry cultivars belong to the floricane-fruiting type, which flower and fruit only on floricanes. Some new blackberry cultivars belong to the primocane-fruiting type, which produces berries on both primocanes and floricanes. The reproductive phenology of both floricane- and primocane-fruiting cultivars grown in central Florida is described below.

Floricane-Fruiting Type

Floricane-fruiting cultivars develop flower buds on primocanes in late fall. Defoliation of floricanes occurs between late December and mid-February, depending on the timing and amount of winter chill. Budbreak occurs from late February to mid-March, and plants produce berries from early May to late June (Lin and Agehara 2020a).

Primocane-Fruiting Type

Primocane-fruiting cultivars produce berries on primocanes from mid-October to late February and again on floricanes from late April to mid-June in the following year. In central Florida, however, fruit production on primocanes is low over a prolonged period. Consequently, only the berries produced on floricanes are harvested in commercial production.

On-farm trials in Central FL (<150 chill hours)

‘Ouachita’ (floricane)

‘Freedom’ (primocane)

Summary

- Gibberellic acid is **not recommended** because of its phytotoxicity.
- Among the tested defoliants, **urea** is recommended because of its **consistent efficacy, favorable safety profile, and low application cost**.
- Urea application can 1) **increase the percentage of budbreak (yield ↑)**, 2) **improve fruit earliness (fruit disorder ↓)**, and 3) **synchronize budbreak (harvest # ↓)**.
- The optimum application timing depends on the cultivar and location – **immediately before natural budbreak (mid-Feb to early March)** to avoid freeze damage and minimize spray injury to newly sprouted buds.
- Urea is effective for **both floricane- and primocane-fruiting cultivars**.

Publications

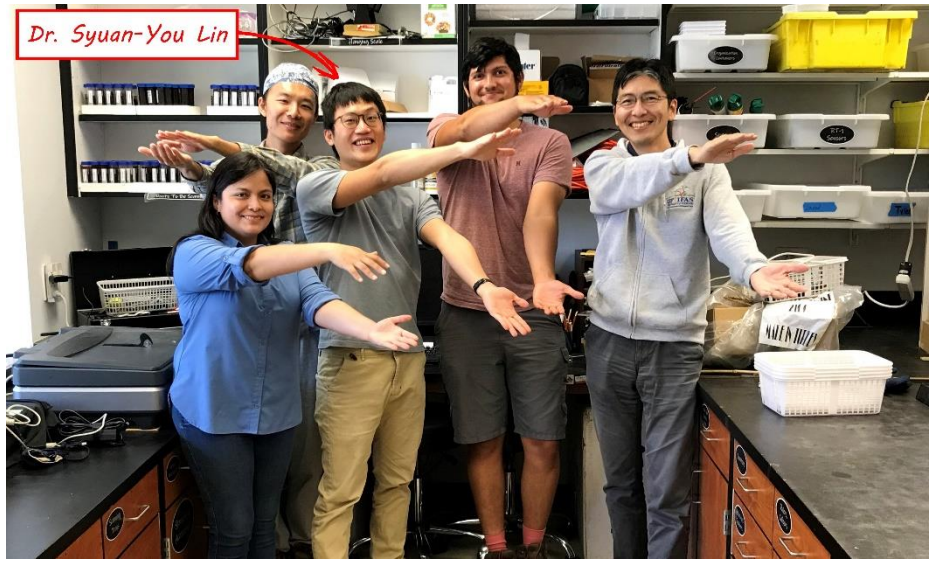
Research articles

1. Lin, S.-Y. and S. Agehara. 2020. Exogenous gibberellic acid advances reproductive phenology and increases early-season yield in subtropical blackberry production. Agronomy 10:1317. doi:10.3390/agronomy10091317
2. Lin, S.-Y. and S. Agehara. 2020. Exogenous gibberellic acid and cytokinin effects on budbreak, flowering, and yield of blackberry grown under subtropical climatic conditions. HortScience 1:1-8. doi:10.21273/hortsci15381-20
3. Lin, S.-Y. and S. Agehara. 2021. Foliar application of defoliants before winter chill accumulation advances budbreak and improves fruit earliness of blackberry under subtropical climatic conditions. HortScience:1. doi:10.21273/hortsci15533-20
4. Lin, S.-Y. and S. Agehara. 2021. Foliar application of defoliants after winter chill accumulation changes phytohormone dynamics and improves budbreak in blackberry under subtropical climatic conditions. Plant Growth Regul. 94:171-181. doi:10.1007/s10725-021-00703-x

EDIS

1. Agehara, S., S.-Y. Lin, and Z. Deng. 2020. Choosing the right blackberry cultivar in subtropical Florida. EDIS HS1352. https://edis.ifas.ufl.edu/publication/HS1352
2. Agehara, S. and S.-Y. Lin. 2021. Chemical budbreak induction methods to increase blackberry yields under inadequate chilling conditions. EDIS HS1352. https://journals.flvc.org/edis/article/view/128580/131181

Acknowledgements



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