Growing Blueberry and Blackberry in a Changing Climate

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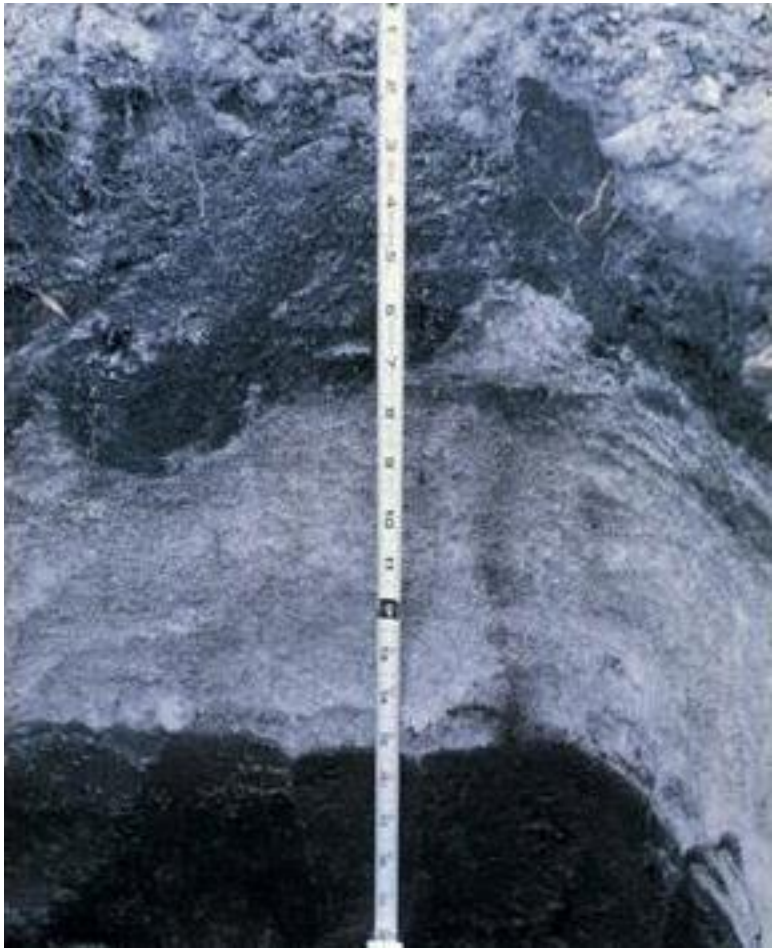
General Requirements of Blueberry

- Acid soils – pH 4.2 to 4.8.
- Soil organic matter content (pine bark)
- Well-drained soil conditions
  - Spodosols can be ideal
- Cultivars grown in Fla. have low-chill requirements
- Traditional deciduous production with chill requirement, or…
- Newer evergreen production without chill requirement

Spodosol



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New planting in native soil without pine bark (unusual in Florida)

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Adaptation of mineral soils (sands) for commercial blueberry production in Florida

- Ideal blueberry soils are coarse, acidic, and high in organic matter.
- Few soils in Florida are naturally suited for blueberry production.
- Most commercial blueberry production in Florida is on highly amended sandy soils.

Examples of SHB planting systems

Bark beds

Bark incorporated into soil

Incorporated bark with ground cloth

Pine bark increases organic matter, decreases soil pH, maintains N in NH_4 form,

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Florida's Winter Climate

- Winter chilling in the southeastern U.S. is highly variable and unpredictable from year to year.
- Late freezes may occur during bloom and early fruit development.
- Freezes are less common in central and south-central Florida but do occur, and chill accumulation can be very low.

Chill accumulation in north and central Florida beginning November 1*

	Long-term Average		Winter 2021/2022		Winter 2022/2023	
Date	Alachua	Lake Alfred	Alachua	Lake Alfred	Alachua	Lake Alfred
Dec. 15	184	47	104	0	51	0
Dec. 31	286	86	123	0	188	74
Jan. 15	388	128	178	4	272	99

- Winter chill accumulation is highly variable by year. Chilling accumulated by December 31 is generally more effective than late winter chilling after hydrogen cyanamide applications are made and after the initiation of bud swell has occurred.

*Data taken from the AgroClimate website.

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Chill accumulation in north and central Florida beginning November 1*

	Long-term Average		Winter 2010/2011		Winter 2011/2012	
Date	N. Florida	C. Florida	N. Florida	C. Florida	N. Florida	C. Florida
Dec. 15	182	46	346	146	139	15
Dec. 31	283	85	520	254	195	22
Jan. 15	384	127	664	307	275	81

- Winter chill accumulation is highly variable by year. Chilling accumulated by December 31 is generally more effective than late winter chilling after hydrogen cyanamide applications are made and after the initiation of bud swell has occurred.

- Winter chilling was well above average during 2010/2011 and much below average in 2011/2012.

*Data taken from the AgroClimate website.

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Chill Accumulation From October to February in three regions of Florida

FAWN Station	Years	Minimum	Maximum	Average
Quincy	17	318	818	611
Alachua	20	270	745	503
Sebring	16	30	299	108

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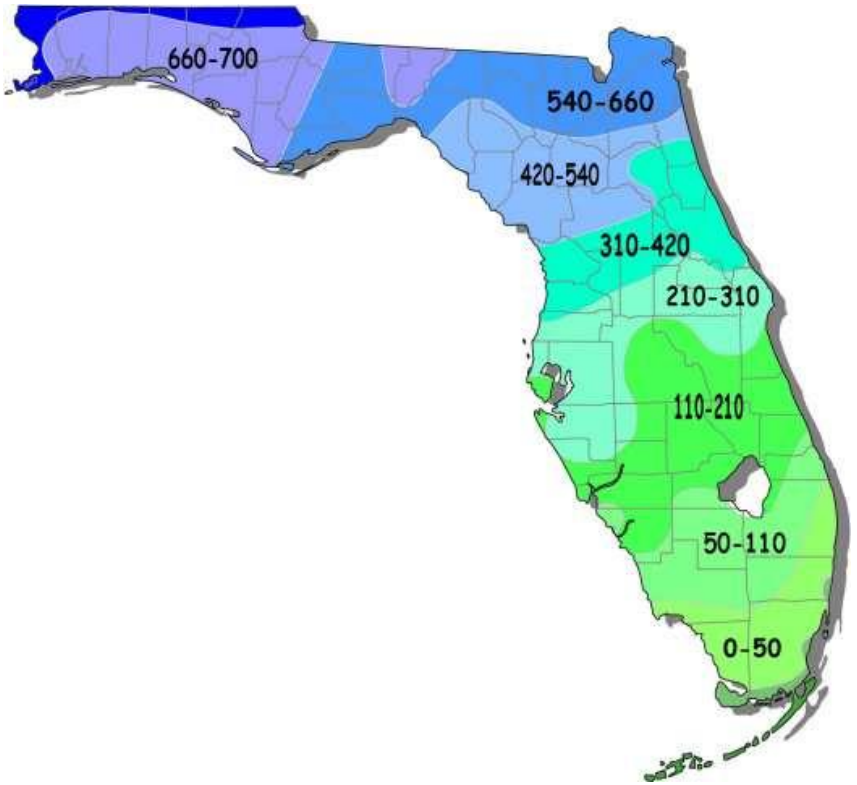
Winter chill unit accumulation

- Map showing typical winter chilling units received during most winters in Florida.
- Chilling varies greatly from year to year.



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Overhead irrigation is needed for reliable production of southern highbush blueberry in areas of Florida where freezes occur.

Damage to plants from the weight of ice may occur.

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Flooding and excessive soil moisture following freeze protection

Wet conditions encourage root diseases and *Botrytis*, and leach fertilizer and other soil-applied chemicals.

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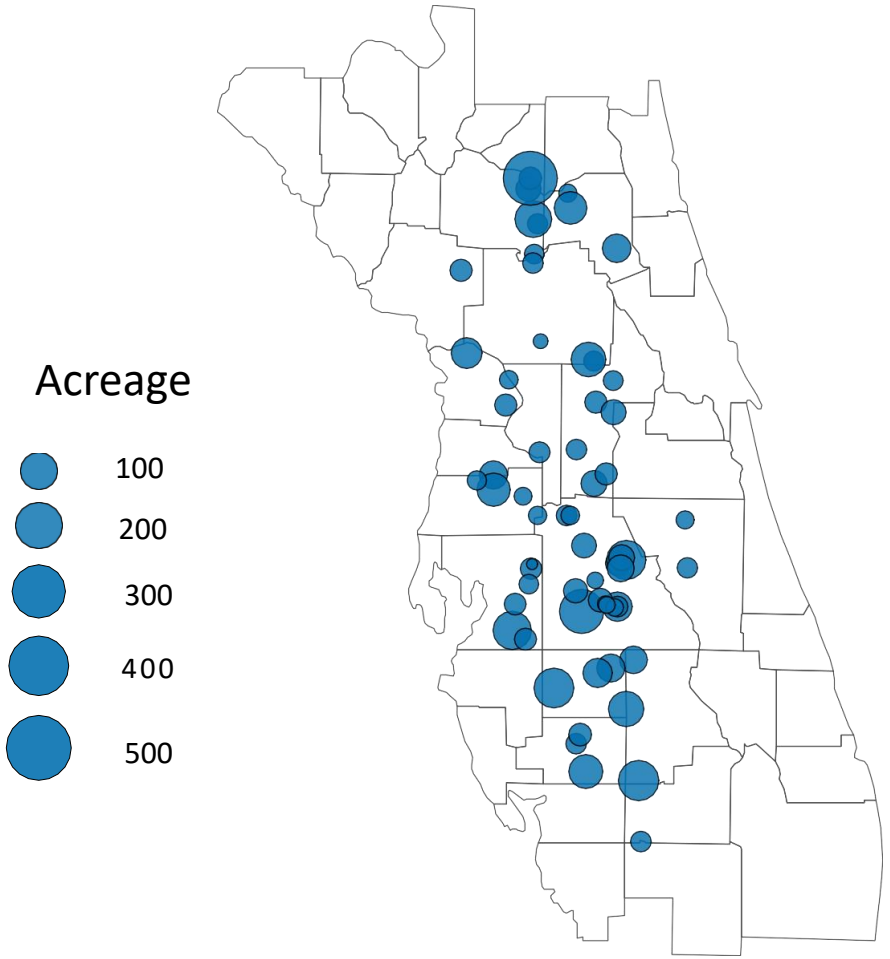
Hurricanes and Tropical Storms

- Plant lodging
- Flooding
- Possible defoliation
- Possible spread of pests and diseases
- Document damage for insurance purposes

Two low-chill blueberry production systems

- Traditional deciduous production system
  - Plants enter dormancy, growth (flowering and vegetative bud break) resumes in late winter (Jan/Feb).
  - Timing of “spring” growth is dependent on many factors including winter temperatures.
  - Often relies on dormancy-breaking compounds in Florida.
- Evergreen or non-dormant production system
  - Plants retain foliage and are managed for dormancy avoidance.
  - Flowering and fruit harvest begin early and extend over a longer time.
  - May be used in combination with greenhouses or tunnels in regions where hard freezes occur.

Commercia southern highbush acreage in peninsular Florida



Relatively new acreage in the south to escape freeze damage. Very low-chill conditions.

Courtesy of Doug Phillips, GCREC, UF.

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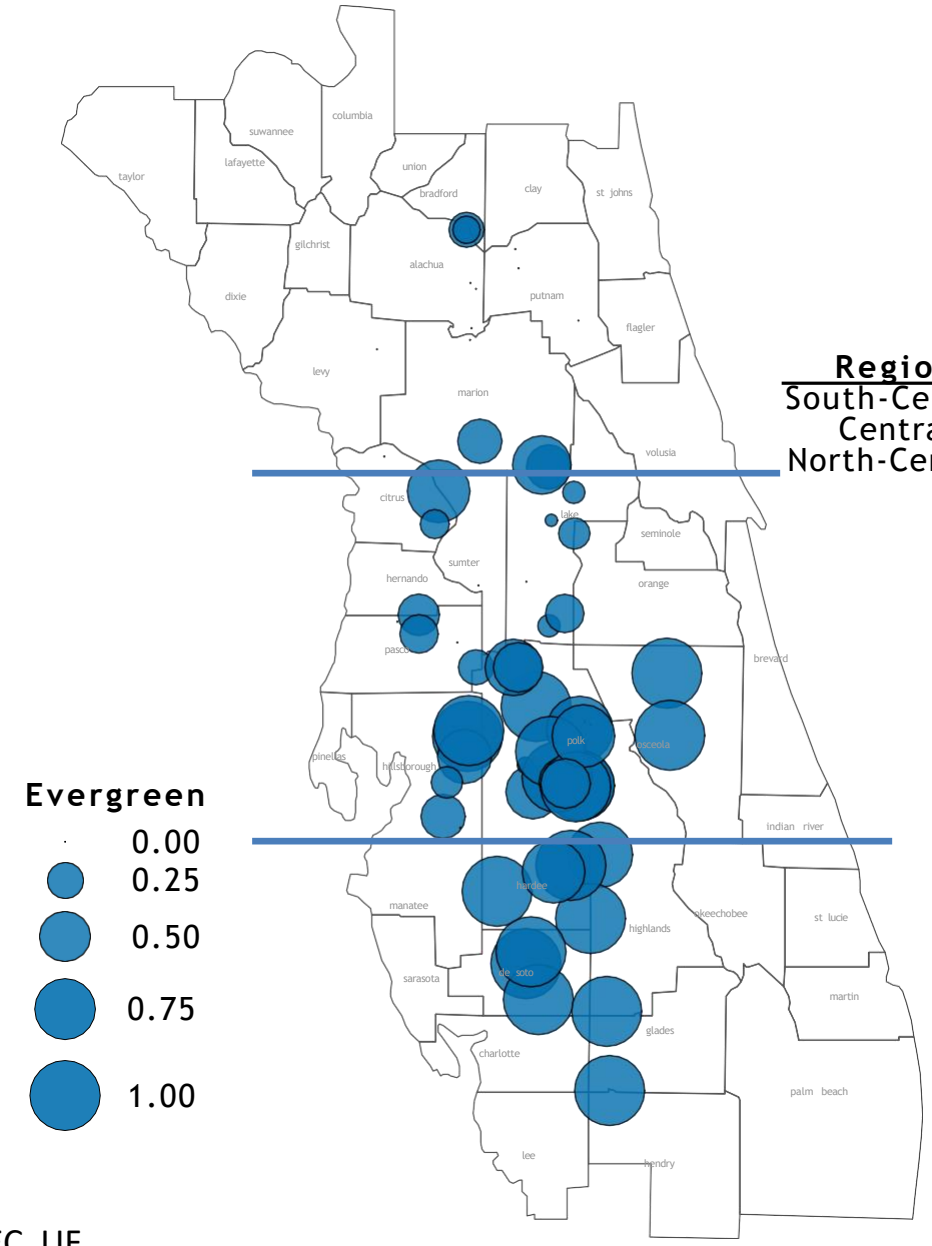
Evergreen Production Reported by Growers



Region	Farms	Evergreen
South-Central	10	0.97
Central	34	0.58
North-Central	2	0.28

Evergreen

0.00
0.25
0.50
0.75
1.00

Courtesy of Doug Phillips, GCREC, UF.

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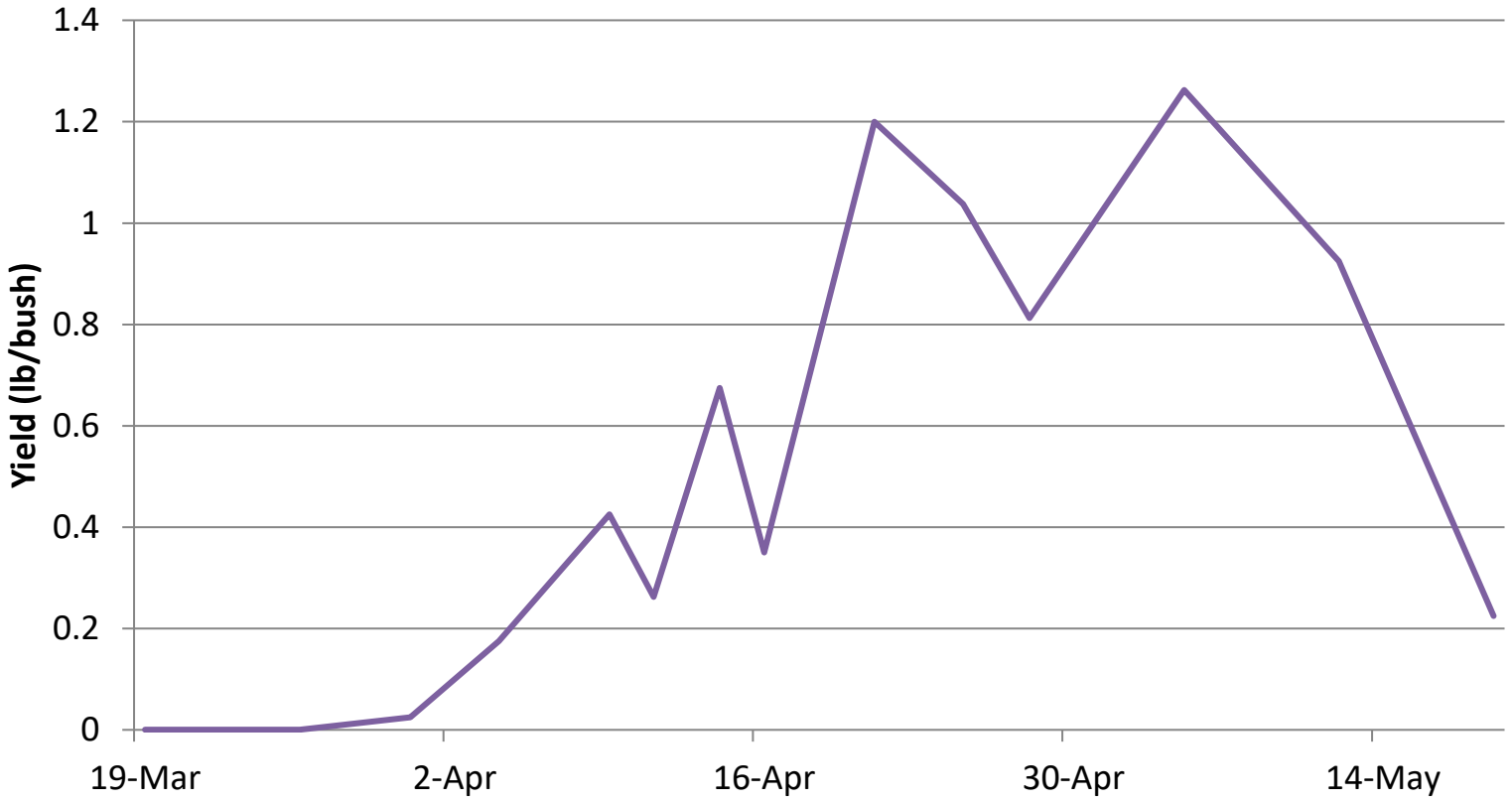
Low-chill blueberry production challenges

- Challenges for traditional dormant production
  - Variable winter temperatures, low chill accumulation often accompanied by intermittent warm weather.
  - Bloom periods are variable and unpredictable.
  - Dormancy breaking compounds are not effective unless plants are dormant and have accumulated some chilling.
  - In climates that experience hard freezes, damaging freezes are likely during and after bloom.
- Challenges for evergreen production
  - Requires low-chill cultivars with "evergreen" tendencies.
  - Extended leaf disease management is needed.
  - Continued maintenance fertilization/irrigation through winter months.
  - Bloom and harvest periods are often extended.
  - Added costs of tunnels, unless grown where hard freezes do not occur.

‘Emerald’ yield by date -traditional deciduous production system – Haines City.



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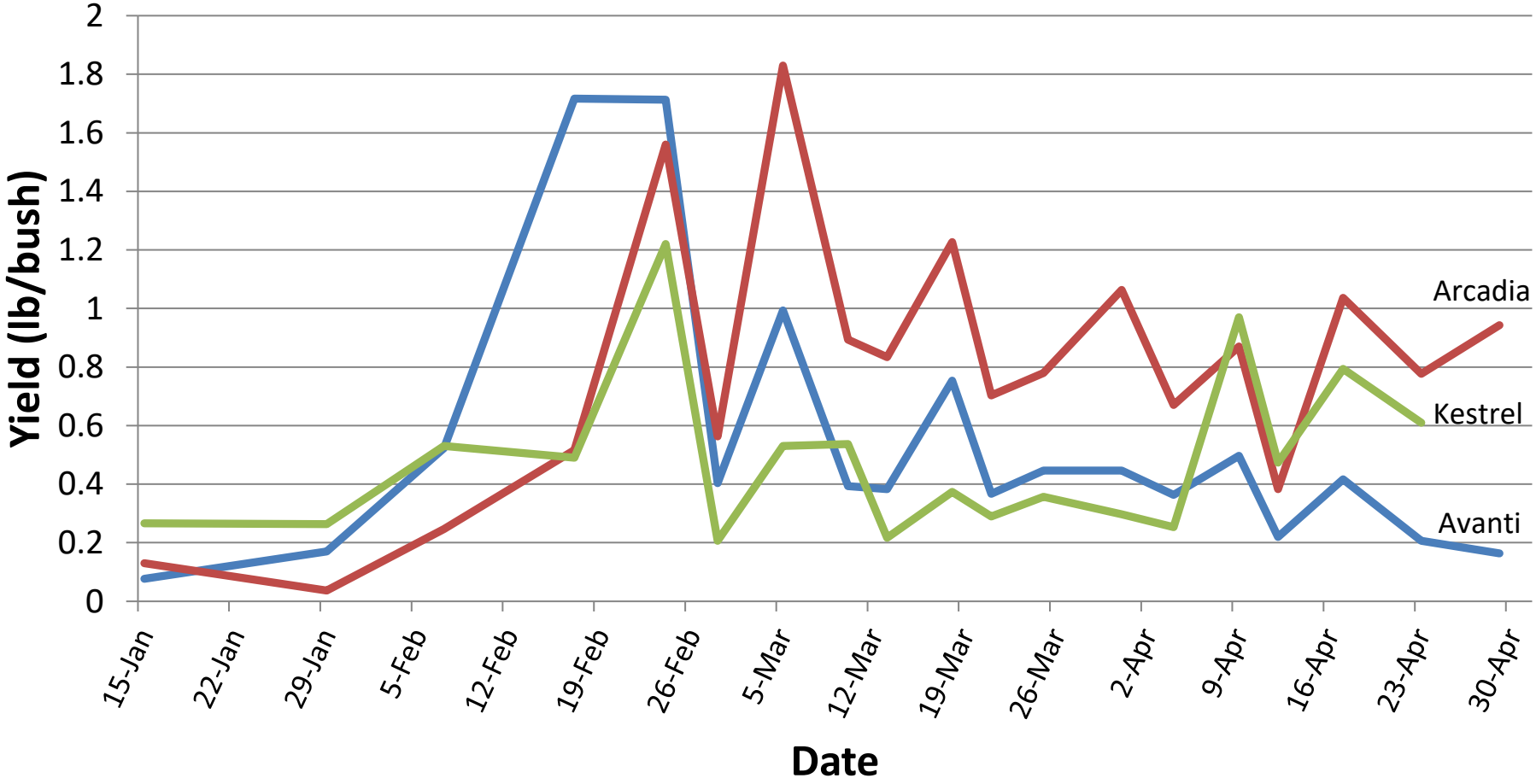
Seasonal yield (evergreen system) – Arcadia, FL



Note the extended harvest season compared to the traditional system

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Evergreen Kestrel i
Arcadia, FL.

Evergreen production in tunnels in north-central Florida

Straughn Farms, Waldo, FL

May be used for the traditional deciduous production system.

Hydrogen cyanamide
(Dormex/Budpro)

- Greater leaf surface area earlier during fruit development results in earlier berry ripening and larger average berry size.

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Potential benefits of hydrogen cyanamide

- May offer certain benefits on some cultivars.
  - Earlier fruit harvest
  - Slight increase in fruit size
  - Slight increase in yield
  - Concentration of bloom period
  - Concentration of fruit harvest
  - Reduced plant stress by reducing poor leafing and over cropping

Recent releases are being selected

none HC conditions.

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Hydrogen cyanamide (Dormex/Budpro) advances vegetative bud break relative to floral budbreak

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Potential disadvantages

- Cultivar-specific response (not all cultivars respond well)
- Phytotoxicity from improper rate, timing, or unusual environmental conditions.
- Phytotoxicity can reduce plant yields.
- Erratic, responses observed in central and south-central Florida, especially during or following warm, low-chill, winters.

What is hydrogen cyanamide? (Dormex®/Budpro®)

- Several commercial formulations of hydrogen cyanamide (50% a.i.).
- Classified as a plant growth regulator.
- Classified as a restricted use pesticide.
- Toxic to humans.
- Product labels have very specific restrictions on how it must be handled and applied.
- Growers without necessary equipment and expertise may consider custom application.

Potential disadvantages of hydrogen cyanamide under low-chill conditions

- Cultivar-specific response (not all cultivars respond well). Some cultivars are sensitive and subject to injury from HC.
- Phytotoxicity can occur even on HC-tolerant cultivars from improper rate, timing, or very low-chill conditions.
- Phytotoxicity can reduce plant yields.
- Phytotoxicity or erratic responses have been observed under low-chill conditions, or on plants that are not fully dormant.

The following cautionary statements are on product labels

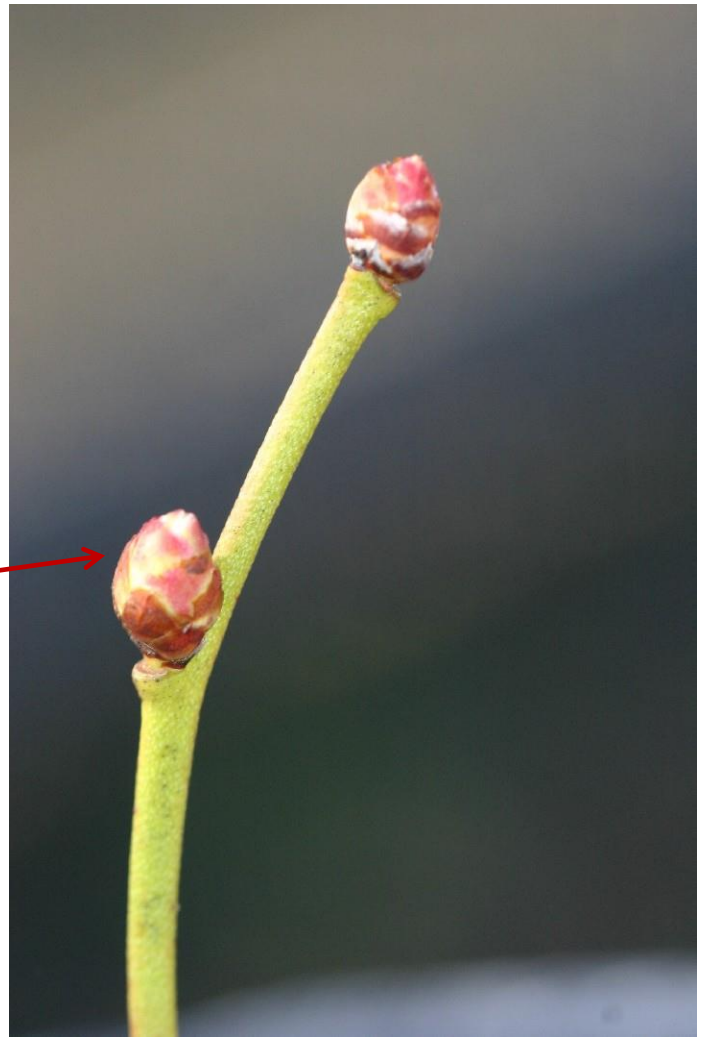
- **DORMANCY REQUIREMENTS** – To promote the maximum effectiveness, and to avoid phytotoxicity (i.e., new wood dieback, blossom thinning), deciduous crops must be completely dormant.

- Not a substitute for a lack of dormancy. Care should be taken to monitor dormancy. This is most easily accomplished by monitoring chill hour accumulation.

- USER NOTE: negative chill hour accumulation, climatologically induced incomplete dormancy must be considered, both to promote the effectiveness at the recommended rates of application and to avoid phytotoxicity.

Early Stage 2 – little to no injury on tolerant cultivars with pre-chilling conditioning

Buds swollen with
bud scales still closed



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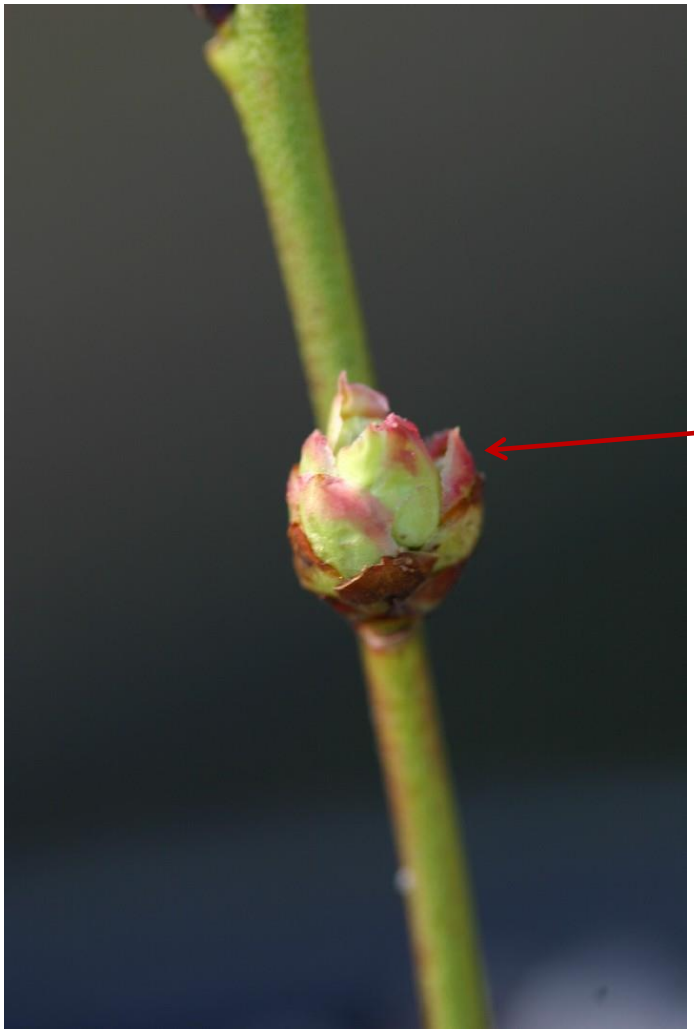
Stage 3 – may get significant injury on tolerant cultivars



Bud scales beginning to open

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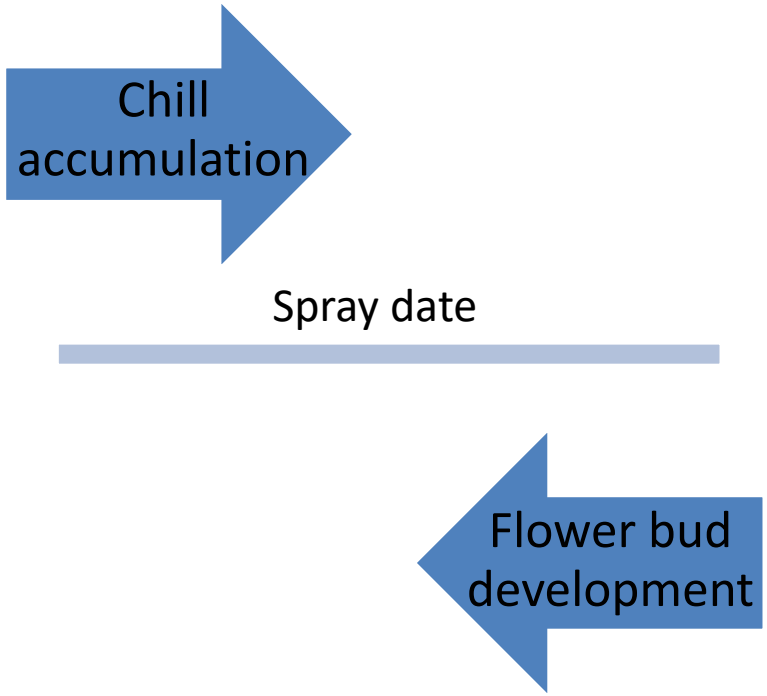
Determining when to spray can be a balancing act

- Dormancy and prior chill accumulation are needed.
- Sprays should be applied before flower bud development advances past stage 2.
- The application window can be very narrow.



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Factors influencing hydrogen cyanamide results

- Dormancy level
- Cultivar
- Bud stage
- Spray concentration
- Spray coverage
- Winter chilling prior to application
- Weather
- Spray volume
- Application method
- Time of day - drying conditions.
- Surfactant

Highest Yielding Cultivars Reported by Region

North-Central

Variety	# Farms Present out of 12	**Highest Yielding**
Farthing	10 (83%)	**50%**
Emerald	4 (33%)	**50%**
Sentinel	5 (42%)	**40%**

Central

Variety	# Farms Present out of 41	**Highest Yielding**
Emerald	30 (73%)	**40%**
Arcadia	36 (88%)	**31%**
Winter Bell	16 (39%)	**25%**
Chickadee	15 (37%)	**13%**
Jewel	22 (54%)	**9%**

South-Central

Variety	# Farms Present out of 10	**Highest Yielding**
Arcadia	9 (90%)	**67%**
Avanti	8 (80%)	**25%**

Compliments of Doug Phillips, GCREC, IFAS, UF.

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Blueberry cultivars in peninsular Florida

Most Profitable by Region

North-Central

Variety	# Farms Present out of 12	**Most Profitable**
Farthing	10 (83%)	**30%**
Springhigh	4 (33%)	**50%**

Central

Variety	# Farms Present out of 41	**Most Profitable**
Chickadee	15 (37%)	**47%**
Winter Bell	16 (39%)	**44%**
Emerald	30 (73%)	**33%**
Kestrel	18 (44%)	**22%**
Arcadia	36 (88%)	**8%**
Springhigh	4 (10%)	**50%**

South-Central

Variety	# Farms Present out of 10	**Most Profitable**
Kestrel	8 (80%)	**38%**
Arcadia	9 (90%)	**33%**

Compliments of Doug Phillips, GCREC, IFAS, UF.

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2021 – 2022 Comparison

	2021 (64 Farms)	2022 (63 Farms)
Highest Yield		
• North	Farthing, Emerald	Farthing
• Central	Arcadia	Emerald
• South	Arcadia	Arcadia
Lowest Yield		
• North	Meadowlark	Colossus
• Central	Meadowlark	Chickadee
• South	Kestrel	Kestrel
Most Profitable		
• North	Chickadee, Emerald	Farthing
• Central	Arcadia	Chickadee
• South	Arcadia	Kestrel

‘Emerald’ (USPP # 12,165)

- Low chill requirement
- High yield potential
- Vigorous, spreading bush
- Large fruit size, good quality, tight clusters
- Long harvest period
- Firmness greater than Jewel but not as firm as some newer cultivars.
- Not considered suitable for machine harvest.

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‘Farthing’ (USPP # 19,341)

- Vigorous, compact growth habit
- Blooms after ‘Emerald’
- High yield potential, long picking season
- Firm fruit, potential for machine harvesting
- Color can be non-uniform (red on back of berry)
- Watch for bud mites, gall midge and algal spot

‘Patrecia’ (USPP # 27,740)

Credit: UF Blueberry Breeding Program

- Upright open architecture
- Later blooming than some southern highbush.
- Large berry size but picking scar may be larger than desirable.
- Good flavor.
- For use in north Florida.
- Not suited for machine harvest.

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‘Optimus’ (PPAF)

Credit: UF Blueberry Breeding Program

- Vigorous plant
- Early-ripening
- Fruit are firm but small by today’s standards.
- Suitable for machine harvesting.
- High yielding but somewhat difficult to harvest by hand due to smaller than average berry size.
- North and north-central Florida.

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‘Arcadia’ (USPP # 26, 313)

- Central and south-central Florida
- Evergreen production
- Very low chill
- Productive
- High fruit quality
- Bacterial wilt disease has been associated with this cultivar.

https://www.blueberrybreeding.com/arcadia-fl07-399?light313box=dataItem-jhsgzbrj

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‘Albus’ (TBD)

- New release from the UF breeding program.
- Vigorous and high yielding as an evergreen.
- Selected for the central Florida region.
- Excellent fruit quality.

https://www.blueberrybreeding.com/blueberryvarieties/albus

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‘Avanti’ (US PP # 26,312)

- Very low chill requirement.
- Good yield potential in evergreen production.
- High fruit quality, fruit may be smaller than some cultivars.
- Susceptibility of *Botytis* fruit rot.
- Higher than average susceptibility to mite and chilli thrips damage.

https://www.blueberrybreeding.com/avanti-fl06-203

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‘Sentinel’ (PPAF)

- Released in 2020.
- Vigorous, early ripening.
- Has performed well in north and north-central Florida.
- Excellent fruit quality.
- Productive
- Does not need hydrogen cyanamide.

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Other cultivars for north Florida and the panhandle

- In extreme north Florida and the Florida panhandle, only a few SHB cultivars from the UF breeding program are likely to produce reliably because of freezes after bloom. Freeze protection is required for SHB production.
  - Southern highbush from UF – ‘Farthing’, ‘Keecrisp’, and ‘Emerald’ for u-pick and local sales in extreme north Florida and the panhandle.
  - A number of rabbiteye cultivars are adapted to these areas (‘Climax’, ‘Powderblue’ and ‘Brightwell’) for U-pick and local sales as well as for home gardening.

The University of Georgia has bred rabbiteyes and some southern highbush for this climatic zone.

Blackberry (*Rubus* spp.) in Florida

- Generally self-fruitful but varies.
- Flower bud formation in late summer and fall. concurrent with cessation of shoot growth.
- Bloom date is later than many crops (Late Feb. - early March).
- Three stages for fruit growth (drupelets, so similar to drupes)
  - Stage 1 (at and immediately following bloom) – rapid cell division
  - Stage 2 – endocarp hardening – slow
  - Stage 3 – rapid growth, cell expansion, continuing until maturity.

Blackberry

- Soil requirements –
  - well-drained sandy loam soil.
  - Soil pH 6.0 – 6.5.
  - Responds well to mulch.
  - Irrigation and weed control important for establishment.

Growth and fruiting habit

Perennial root and crown system and biennial canes

- Primocanes – canes that emerge and grow vegetatively (may or may not fruit the first year).
- Floricanes – Canes that developed the previous year and bear fruit the second year before dying.

Fruiting habit

Floricane fruiting (most common) – fruits only on floricanes (second year canes). After fruiting the floricanes die.

Primocane fruiting – will fruit in late summer/fall on upper 1/3 of primoncanes. The lower flower buds open the following year. Can potentially get two crops per year.

Weather factors that may influence blackberry success in Florida

- Summer heat – poor fruit quality
- Summer rainy season – poor fruit quality
- Low chilling in winter – low vigor and yield, plant stress = greater disease

Blackberry production in Florida

- Chilling requirements and other weather factors
  - Most commercial cultivars were developed in Arkansas and are only marginally adapted to Florida's climate.
  - Many Arkansas cultivars suffer from lack of winter chilling when grown in Florida.

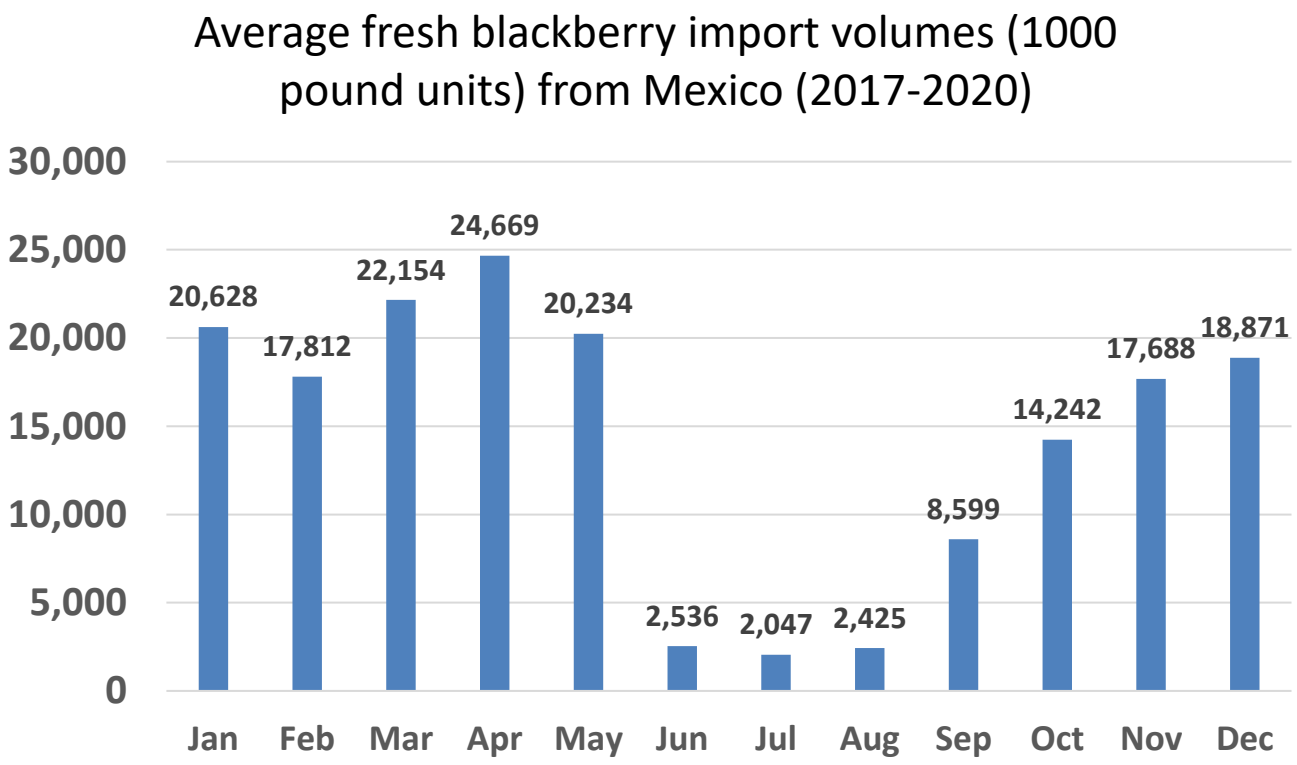
- Where does Florida fit into the market?

Blackberry imports to U.S. based on 4-year totals.

Country	Share	1000 lb. units
Mexico	97.6%	189,968
Guatemala	2,4%	4,931
Canada	0%	38
Chile	0%	27
Columbia	0%	10

Courtesy of Z. Deng.

Blackberries



Courtesy of Z. Deng.

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Main Cultivars for Florida

- 'Ouachita' – thornless, about 500 chill hours, mid to late season.
- 'Osage' – semi-erect, thornless, good fruit quality, approx. 300 chill hours. One of the lowest chilling of the thornless Univ. Arkansas varieties.
- 'Kiowa' – thorny; has done well in South Georgia and North Florida, large fruit size, does not ship well, good for local sales. Slightly lower chilling than Ouachita.
- 'Tupy' – Probably lower chilling than above cultivars (200-300 hours); thorny; may be adapted to mild winter climates in north-central Florida (developed and grown in Brazil).

‘Ouachita’

- Thornless, erect
- Berry size 6-7 g
- Ripens mid-season
- Yields usually among highest of any Ark. thornless.
- Flavor near that of Navaho; 10% SS
- PH potential much like Navaho
- Mid-chilling – about 400 – 500 hrs (est.)
- Widely adapted and planted cultivar.

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‘Ouachita’ in north-central Florida

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‘Osage’

- Thornless
- Erect
- Self fruitful
- Firm, medium-sized berry (6-7 grams)
- Excellent flavor
- Good postharvest and shipping qualities
- Apporx. 300 chill hours

https://www.emcocal.com/osage-2/

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‘Osage’

- Erect, thornless
- Chilling requirement approx. 300 hours.
- Low chilling requirement makes it a good choice for Florida.
- Fruit size – medium (5g)
- Slightly earlier than ‘Ouachita’

Currently, ‘Ouachita’ and ‘Osage’ comprise about 80% of the acreage in Georgia. Dr. Jonathan Oliver, UGA, personal communication.

Prim-Ark® Freedom and Sweet-Ark™ Ponka

- Prime-Ark Freedom released in 2014 is the world's first primocane-fruiting and thornless commercial blackberry variety. Home garden and local market.
- Sweet-Ark Ponka released in 2019. Medium-sized fruit with enhanced sweetness and reduced acidity. Home garden, local, and shipping.
- In the southeast, the primocane fruit yields have been very low due to summer heat.

Prime-Ark Freedom

Sweet Ark Ponca

Credits - https://aaes.uada.edu/fruit-breeding/blackberries

‘Kiowa’

- Thorny
- Moderate chilling (about 300 hrs)
- Productive
- Large size
- Good for local sales
- Poor distant shipper
- Grown commercially in Guatemala.

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‘Tupy’

- Developed in Brazil
- Thorny, erect
- Large, 7-9 g
- Ripe “early to mid-season”
- Yield - 3.8 kg/plant in Brazil; roughly 9-15,000 lb/a
- Flavor - well balanced sweetness/acidity”; some bitterness noted in Arkansas
- PH handling – very good in Mexico
- Chilling likely 200 hrs.

‘Tupy’ – a common commercial cultivar in central America

Massive thorns

Tupy

- Trial plantings in low-chill areas; likely not hardy in mid to upper South
- Very nice large berry with name recognition
- Rain during harvest results in postharvest problems
- Be careful with the thorns!

Common blackberry diseases

- Anthracnose – small purple lesions on canes. Remove and burn infected canes.
- Leaf spots – dark red spots with white centers.
- Crown gall – soil-borne bacterium. Tumors on crown. Spreads through wounds.
- Rosette (double blossom) – Abnormal flowering, witches broom effect, Remove infected canes to the ground after harvest. Can become systemic.
- Orange rust – bright orange masses on underside of leaves. Can become systemic. Plant removal.
- Algal cane blotch (orange felt) – cane disease, causes defoliation, Cu fungicides.

Orange felt(algal cane blotch) (*Cephaleuros virescens)* on blackberry – a serious problem in central Florida

https://msfruitextension.files.wordpress.com/2012/03/blackberriesmarch162012-orangefelt.jpg

There are a variety of leaf spot diseases

Blackberry rust

https://www.alamy.com/stock-photo/blackberry-rust.html

Cercospora leaf spot

https://bramblescout.ca.uky.edu/cercosporaleafspot

Common Insect Pests

- Thrips
- Spider mites (dry weather)
- Raspberry crown borer
- Stink bugs
- Spotted wing drosophila (new pest)
- Sap beetles – keep ripe fruit picked

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University of Florida/IFAS Blackberry Breeding Program

- Focused on developing low chill varieties that are better adapted to Florida's warm winters and produce high yields of quality berries
- Thornless, erect, tolerant to diseases
- Initiated in 2015 at the Gulf Coast Research and Education Center, Balm
- Based on University of Arkansas' germplasm, but crossing and selection done in central Florida
- 20 new selections made, in both floricane- and primocane-fruiting types
- 4 selections in growers trials; more selections available for trials in 2022
- Breeder: Zhanao Deng, zdeng@ufl.edu, (813) 419-6605
- Plan to release some cultivars in late 2023

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Summary

- Blackberries can be grown in much of Florida but may suffer from lack of chilling, especially in more southern locations.
- Current thornless cultivars that were developed at the University of Arkansas are not ideally suited for much of Florida. However, some have done reasonably well where winter chilling is 300+ hours.
- Florida will have to compete in the market with other production regions such as Georgia and Mexico.
- A blackberry breeding program has been established recently and may result in improved low-chill thornless cultivars suitable for Florida (Dr. Zhanao Deng, Gulf Coast Research and Education Center, IFAS, UF zdeng@ufl.edu).


Thank You!
Questions?
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