Considerations of alternative tree crops - avocados, lychee, longan, and mango for Central Florida

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Key factors for tropical and subtropical fruit production

- *Tropical fruits: warm to hot temperatures year-round for these crops*
- *Subtropical fruits: may require (lychee) or benefit (avocado, mango, longan) from cold non-freezing temperatures*
- *Site selection: none to infrequent freezing temperatures is best*
  - *Micro-climates*
  - *Nearness to water*
  - *Prepare cold protection strategies – irrigation, tree wraps, cultural practices*
- *Well drained soils and/or well-formed beds and drainage system*
- *Tree size management to minimize tropical storm and hurricane damage*
  - *Preparedness for hurricanes*
  - *Preparedness for flooding and/or continuous saturated soil conditions*

General climatic perspectives - temperatures

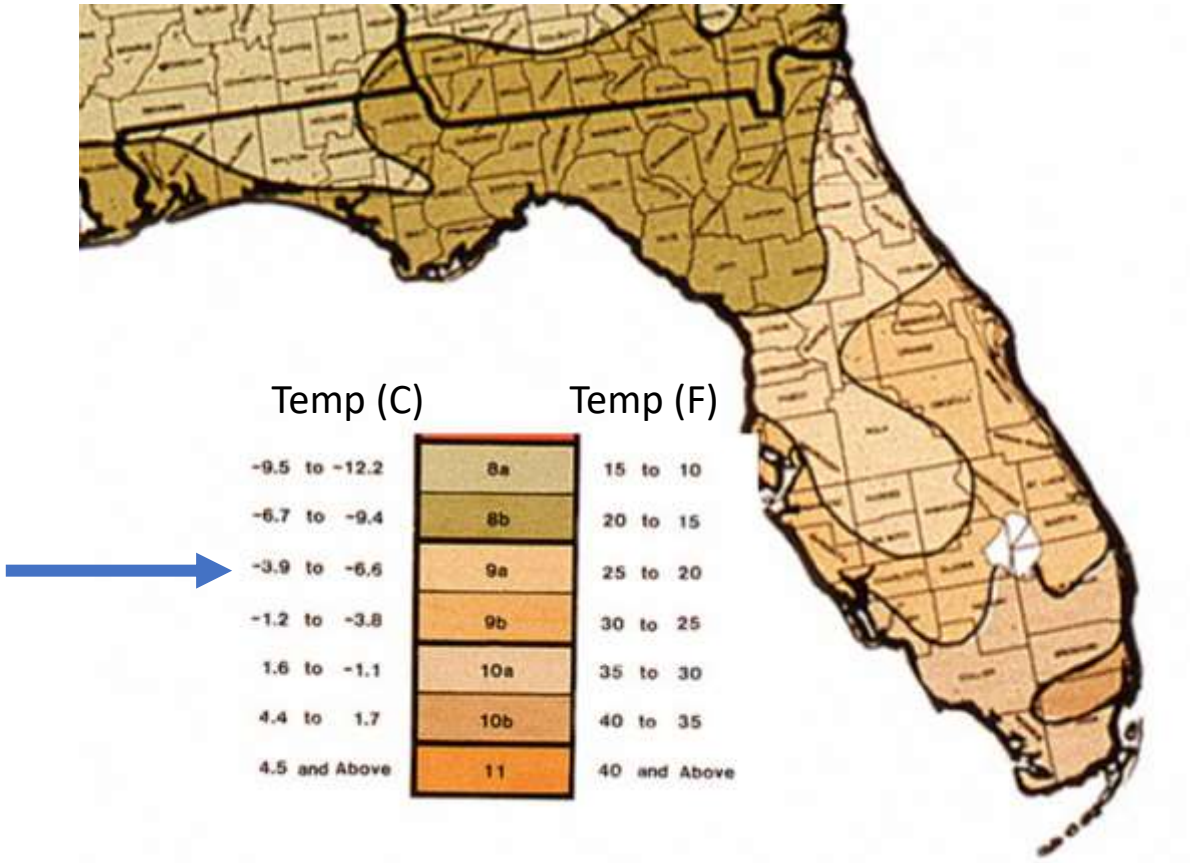
Historically

- Tropical and subtropical fruit crops have been tested throughout Florida since the late 1800s
- Most survived in Miami-Dade County, some coastal areas and some micro-climates in Central Florida
- But in Central Florida the majority died from freezing events

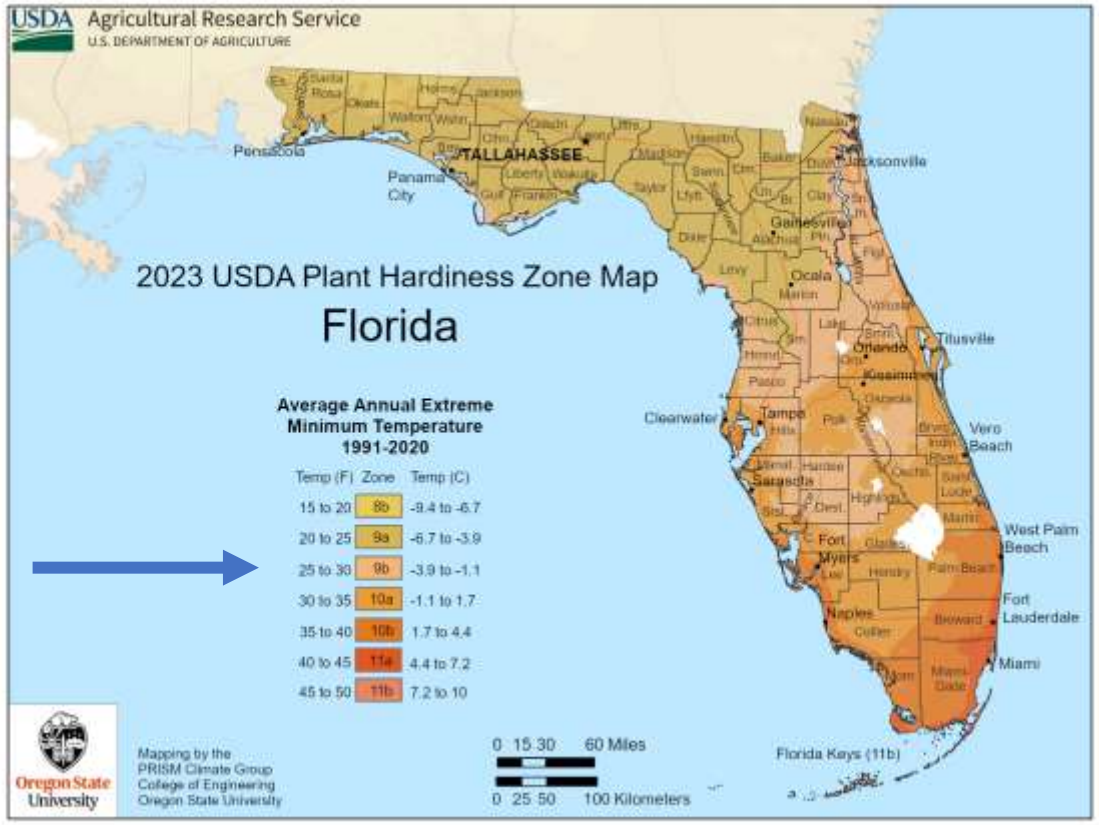
Plant hardiness zones

For example, St. Lucie County 1990 was Zone 9b and now in Zone 10a/10b

Florida 1990



Florida 2023



https://planthardiness.ars.usda.gov/ and https://webgrower.com/hardzone/

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Potential for expansion of tropical fruit crops

Past

Present/
Future?

What counties reported commercial production

Fruit crop	County (2022 USDA Ag Census of Ag, Table 31) (____ = highest acres)
Avocado	Alachua, Brevard, Broward, Collier, DeSoto, Hamilton, Hardee, Hendry, Hillsborough, Indian River, Lake, Lee, Manatee, Marion, Miami-Dade, Orange, Osceola, Palm Beach, Polk, Volusia
Longan	Brevard, Broward, Hillsborough, Lee, Martin, Miami-Dade, Palm Beach, St. Lucie
Lychee	Brevard, Broward, Hamilton, Highlands, Hillsborough, Indian River, Lee, Manatee, Martin, Maimi-Dade, Osceola, Palm Beach, Polk, St. Lucie, Sarasota
Mango	Brevard, Broward, Charlotte, Collier, Hendry, Hillsborough, Indican River, Lake, Lee, Manatee, Martin, Miami-Dade, Orange, Osceola, Palm Beach, Polk, St. Lucie

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Cold tolerance and chilling

Freezing temperatures (≤32°F)

- Tolerance to freezing temperatures varies by fruit species and sometimes cultivar
  - Subtropical fruit crops
  - Tropical fruit crops
- Considerations
  - Lowest temperature reached
  - Frequency of freeze events
  - Duration of freezing event
  - When freezing/frost occurs

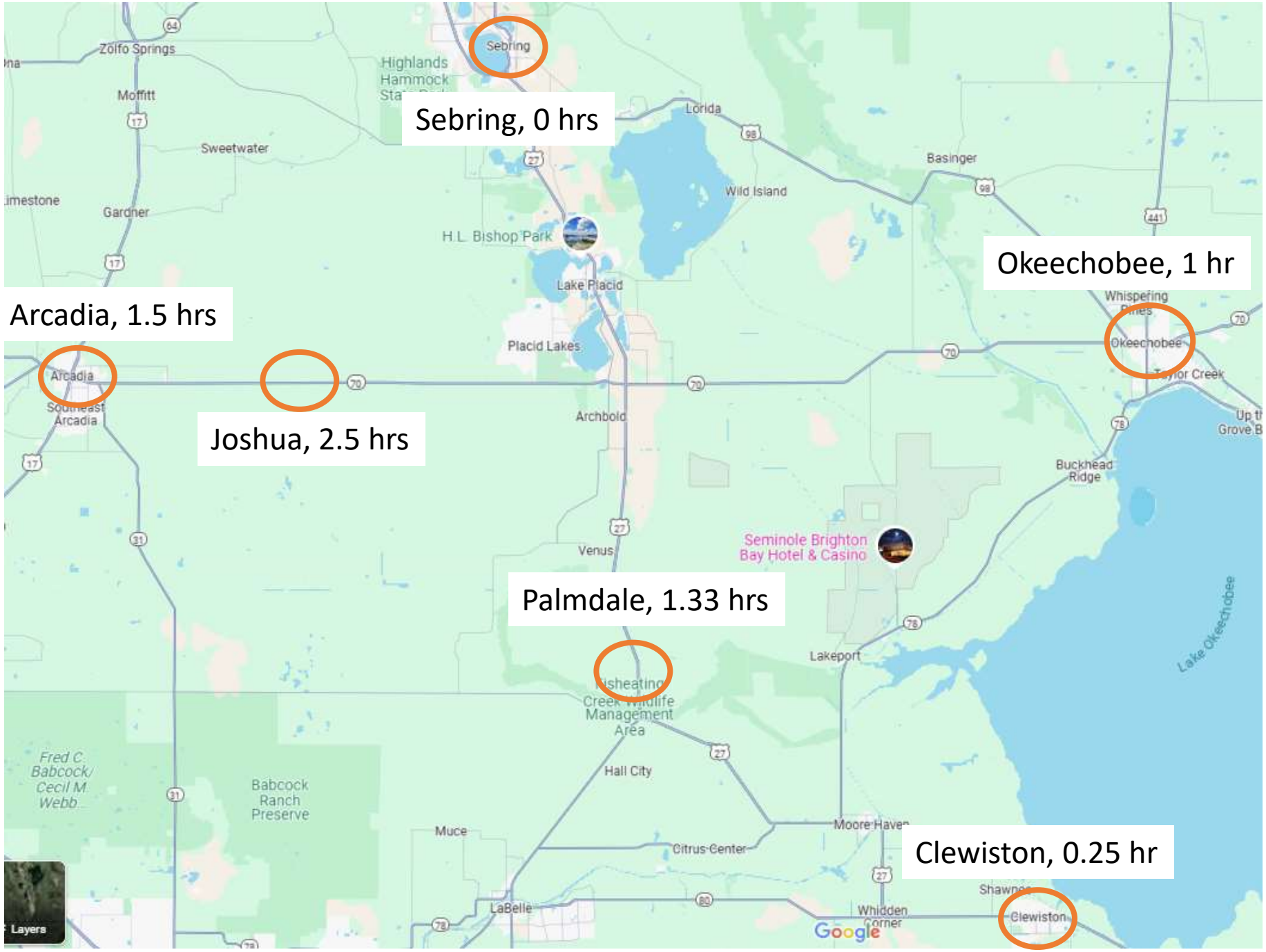
Chilling temperatures

- Temperatures above freezing but below ~55°F-65°F (crop dependent)
- Same considerations as freezing temperature
- Causes physiological problems
  - Reduced or eliminate fruit set
  - Fruit unable to ripen properly
  - Prolong fruit development time
  - Reduced fruit quality

Cold temperature tolerance – the temperature at which damage or death may occur

Common name	Temperature (F°)	Common name	Temperature (F°)
Atemoya/sugar apple	M, 28-29/32; Y, 30/32	Mamey sapote	M, 28; Y, <32
Avocado*	W, 25-30; G, 25-28; M, 18-26	Mango	M, 25; Y, 29-30
Banana	<28	Olive	~12 (28 fruit)
Canistel	M, 23; Y, 29	Papaya	<30
Carambola	M, 26-28; Y, 27-32	Passion fruit	<32
Guava	M, 25-26; Y 27-28	Pitaya	~31?
Jackfruit	<32	Pomegranate	~10-15
Jujube (Chinese/Indian)	-28 to 10	Sapodilla	M, 26; Y 30-32
Kumquat	<18	Spondias	<30
Longan	M, 24-28; Y, 28-30	Tamarind	~24
Loquat	Dormant 10, fruit <27-28	Wax jambu	<32
Lychee	M, 24-25; Y, 28-32	White sapote	M, 24; Y, 26
*W=West Indian; G=Guatemalan race; M=Mexican race; M=mature; Y=young			

- *Genetics*
- *Site selection*
- *Preparation*
- *Phenology*



Hours of temperatures <33°F 2020-2025

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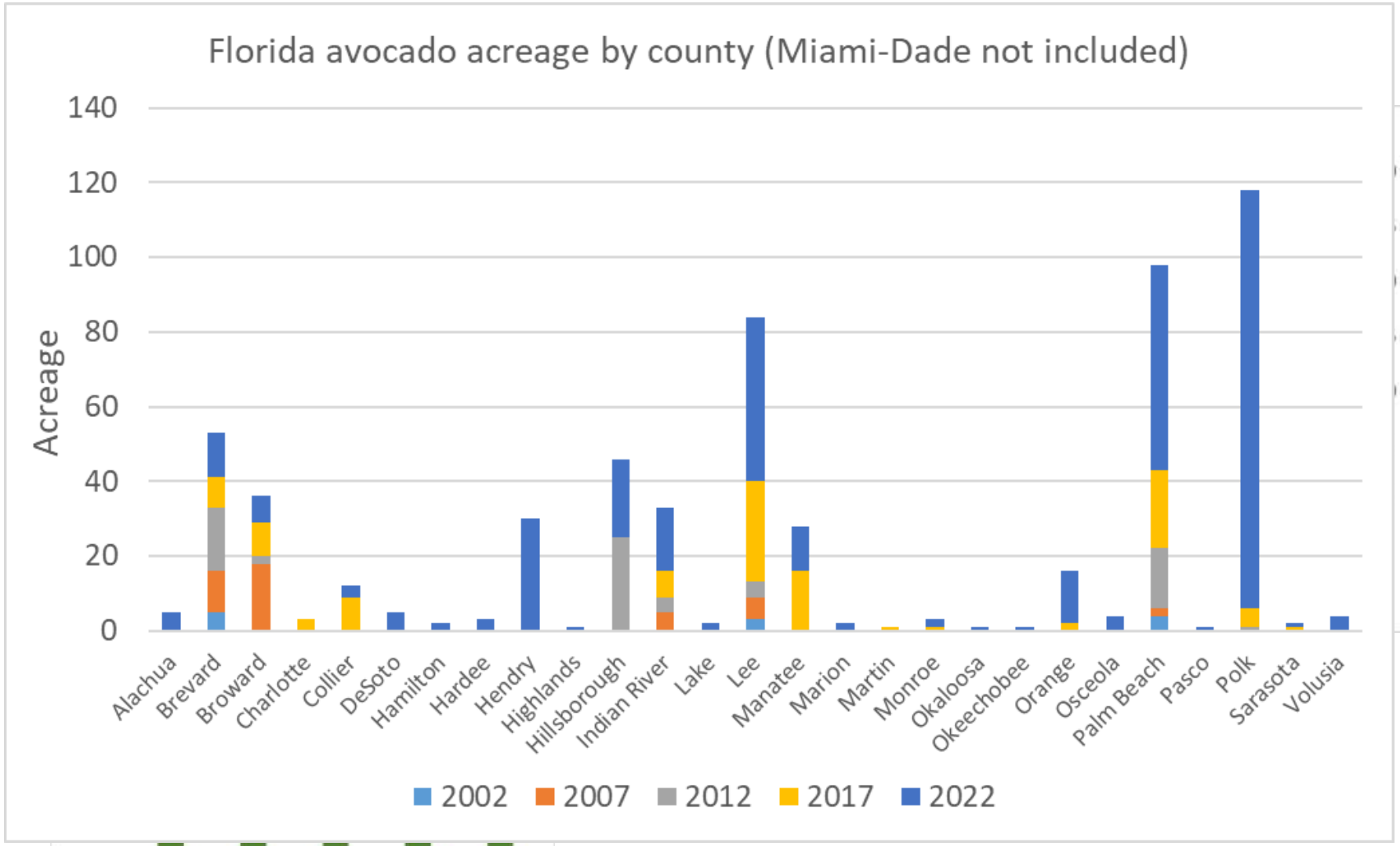
EXAMPLE OF CLIMATE AND POTENTIAL FOR AVOCADO, LYCHEE AND MANGO

NOTE – THE FUTURE PREDICTIONS ARE PREDICTIONS AND AS MODELS CHANGE SO WILL THE PREDICTIONS

Acknowledgement: Some slides are taken from Dr. Young Gu Her, Agricultural Engineering (climate change, sea level rise)

USDA Census of Agriculture



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Environmental parameters for avocado

Ecotype	Opt. temp. range (°F)	Freeze damage on mature trees (°F)	Heat damage (°F)	Comments
West Indian	72-95	25-30	>100	Least cold hardy type grown in Florida.
Guatemalan	55-75	21-25	>90	More cold hardy, only a few commercial cultivars.
Mexican	50-70	18-25	>90	Most cold hardy, only a few cultivars.
WI x G hybrids	70-91	24-30	>90	Variable cold hardiness, most common type cultivars grown in Florida.
G x M hybrids	65-86	20-27	>90	In general, more cold hardy than WI x G but not much experience with most California hybrids.
West Indian (WI), Guatemalan (G), and Mexican (M) ecotypes and WI-G hybrids and G x M hybrids				

Risks

Issue	Comments
Freeze events	Potential for more severe and frequent freeze events north of south Florida. Outside Miami-Dade Co., less experience with preparing for and recovering from freeze events with avocado trees without access to high volume irrigation systems. So far, few quality avocado cultivars with superior cold/freeze tolerance
Flooding	Soil type and location dependent. Some well drained soils, some soils with hardpans, some areas with low-lying land where establishment of beds and/or drainage infrastructure is needed; some potential for mitigation of a flood event through post-storm pruning
Phytophthora root rot	Lack of PRR rootstocks and nurseries to produce them; some fungicides registered but to be effective should be applied before a flood event

Risks

Issue	Comments
Hurricanes	Experience with preparing for and recovering from hurricanes; tree size control
Laurel wilt	• Miami-Dade Co., experience with LW mitigation, a few cultural practices i.e., increasing light and wind movement in groves through regular pruning program; on-going research efforts on controlling LW • Outside Miami-Dade Co., no experience with mitigating LW-AB although could adapt already established cultural practices to reduce incidence of LW outbreaks; will benefit from ongoing LW research
Competition	Major avocado producers – i.e., Mexico and the Dominican Republic

Environmental parameters

Ecotype	Optimum temp. (°F)	Freeze damage (°F)*	Heat damage (°F)
West Indian	72-95	25-30	>100
Guatemalan	55-75	21-25	>90
Mexican	50-70	18-25	>90
WI x G hybrids	70-91	24-30	>90
G x M hybrids	65-86	20-27	>90

*, mature trees

- WI, least cold hardy
- G, more cold hardy but few commercial cv
- M, most cold hardy but few commercial cv
- WIxG, variable cold hardiness
- GxM, in general more cold hardy than WIxG hybrids

Cold hardiness of avocado ecotypes

Character	West Indian	Guatemalan	Mexican
Young trees (°F)	***28 to 30***	***26 to 28***	***24 to 26***
Mature trees (°F)	25 to 30	21 to 25	18 to 25
Freeze tolerance is influenced by genetics, plant stage of growth, depth-duration-frequency of freeze events			

[1], Hybrids have intermediate characteristics.

What does a warming climate mean to tropical fruit trees?

EXAMPLE - Avocado – West Indian Ecotypes

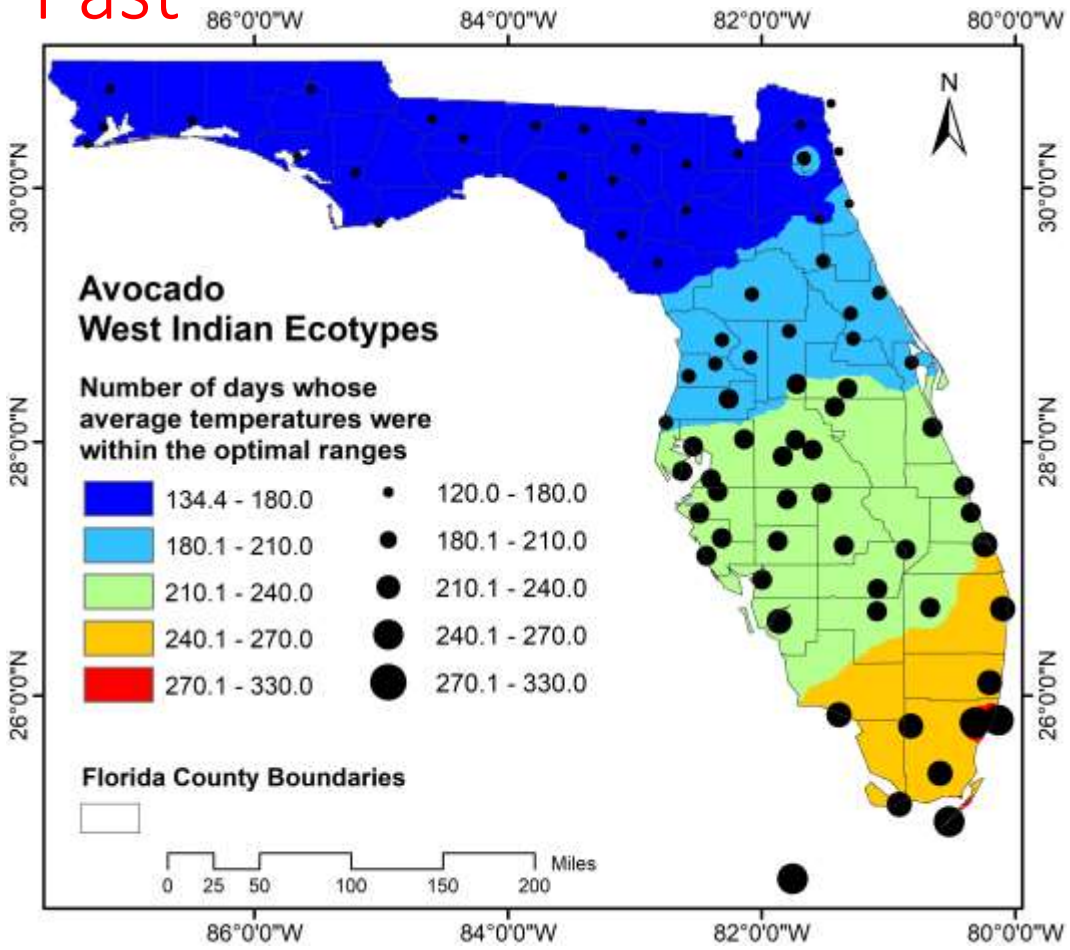
Tropical and subtropical fruits under Florida conditions	Optimum growing temperature range (F)	Freeze damage at or below range (F)*mature trees	Heat damage effects at or above range (F)	Sensitivity to constant winds	Flood tolerance	Plant and/or rootstock salinity soil and/or water tolerance	Drought tolerance
Avocado							
West Indian ecotypes	**72-95**	**25-30**	**>100**	**Not reported**	**Sensitive-intolerant**	**Most tolerant**	**Moderately tolerant**
Guatemalan ecotypes	55-75	21-25	>90	Not reported	Sensitive-intolerant	Intermediate tolerance	Moderately tolerant
Mexican ecotype	50-70	18-25	>90	Not reported	Sensitive-intolerant	Least tolerant	Moderately tolerant
West Indian x Guatemalan hybrids	70-91	24-30	>90	Not reported	Sensitive-intolerant	Varies	Moderately tolerant
Guatemalan x Mexican hybrids	65-86	20-27	>90	Not reported	Sensitive-intolerant	Varies	Moderately tolerant

What do the changes mean to tropical fruit trees?

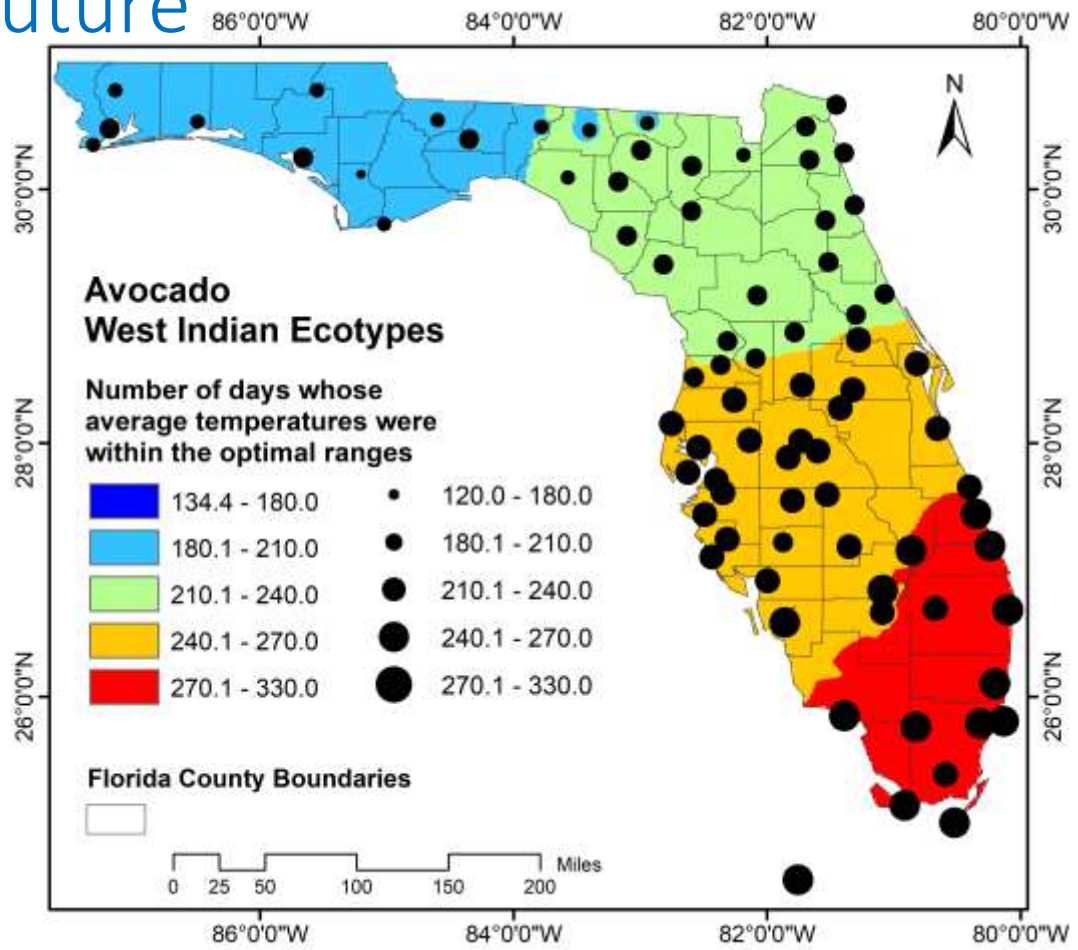
Areas with optimal temperature

How many days did we have optimal temperatures for growing tropical fruit trees?

Past



Future

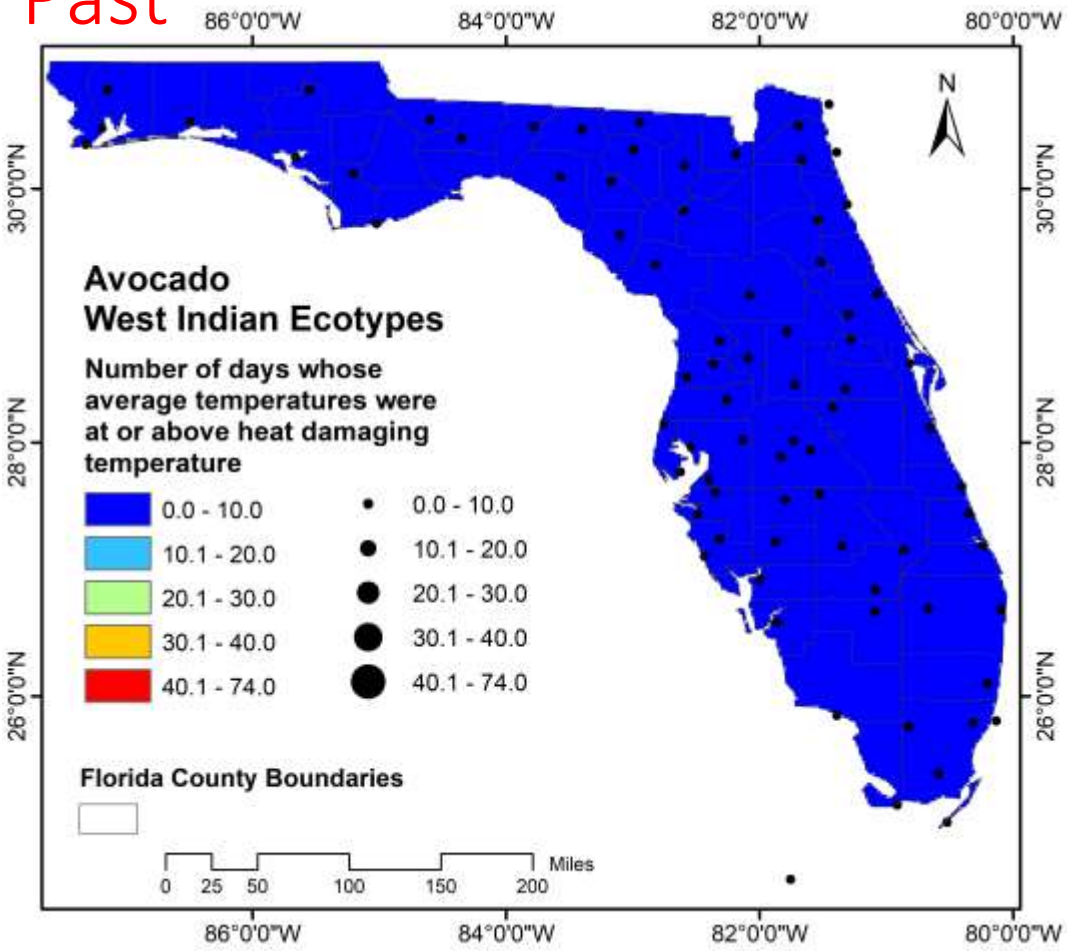


What do the changes mean to tropical fruit trees?

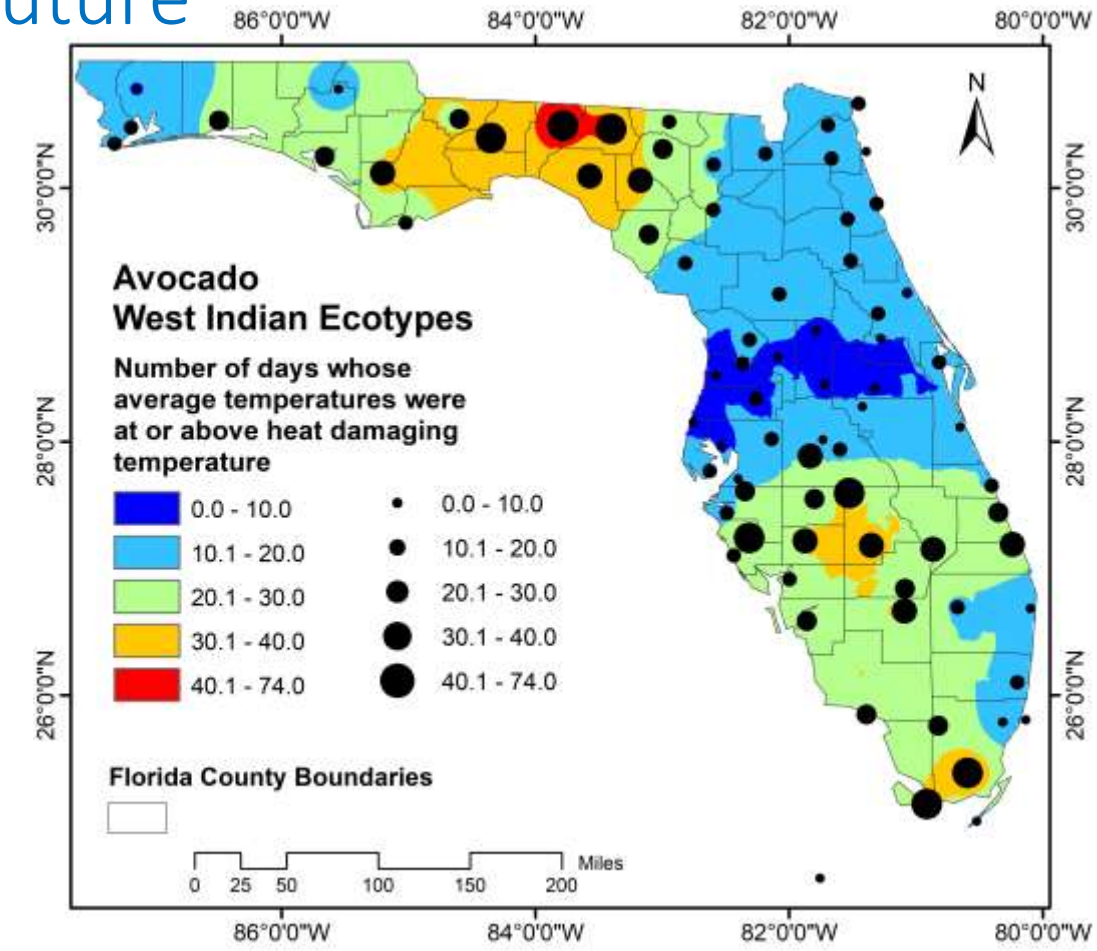
Areas with potential heat damage

How many days did we have maximum temperatures that were at or above heat damaging temperature?

Past



Future

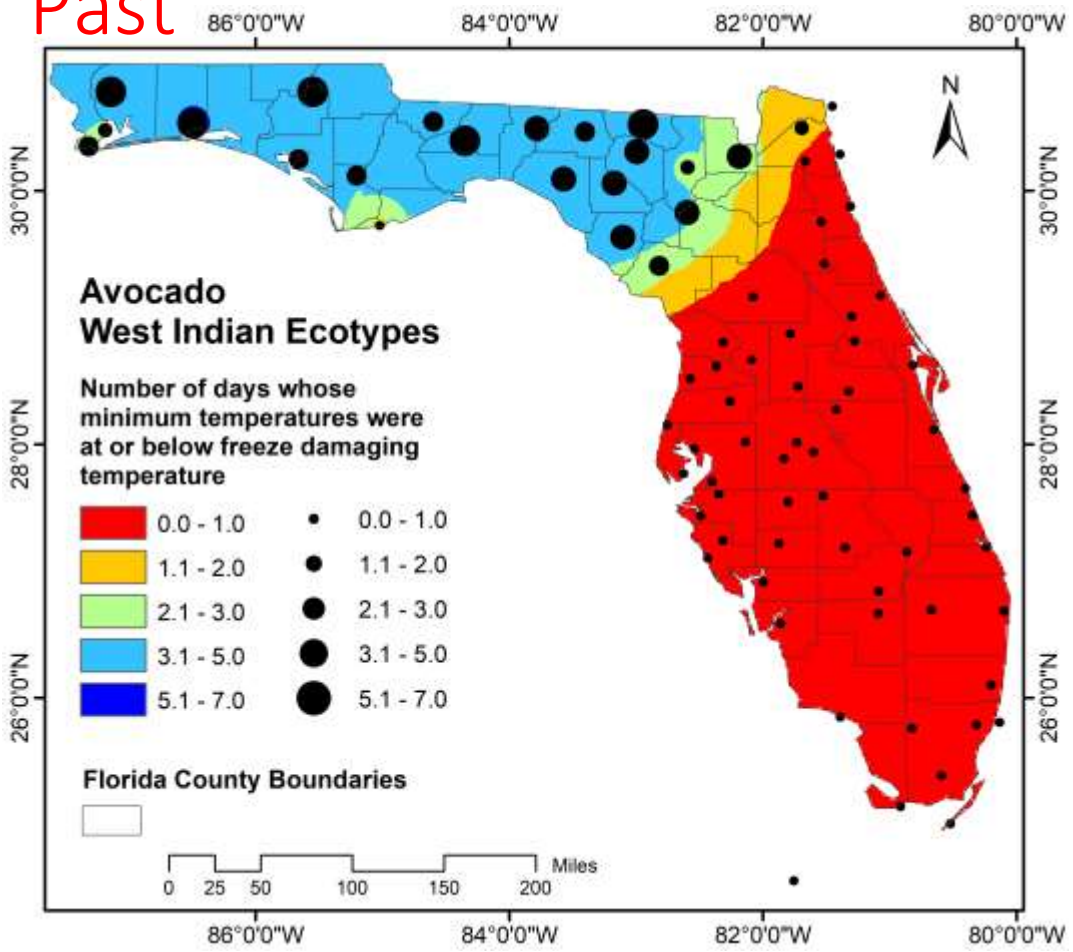


What do the changes mean to tropical fruit trees?

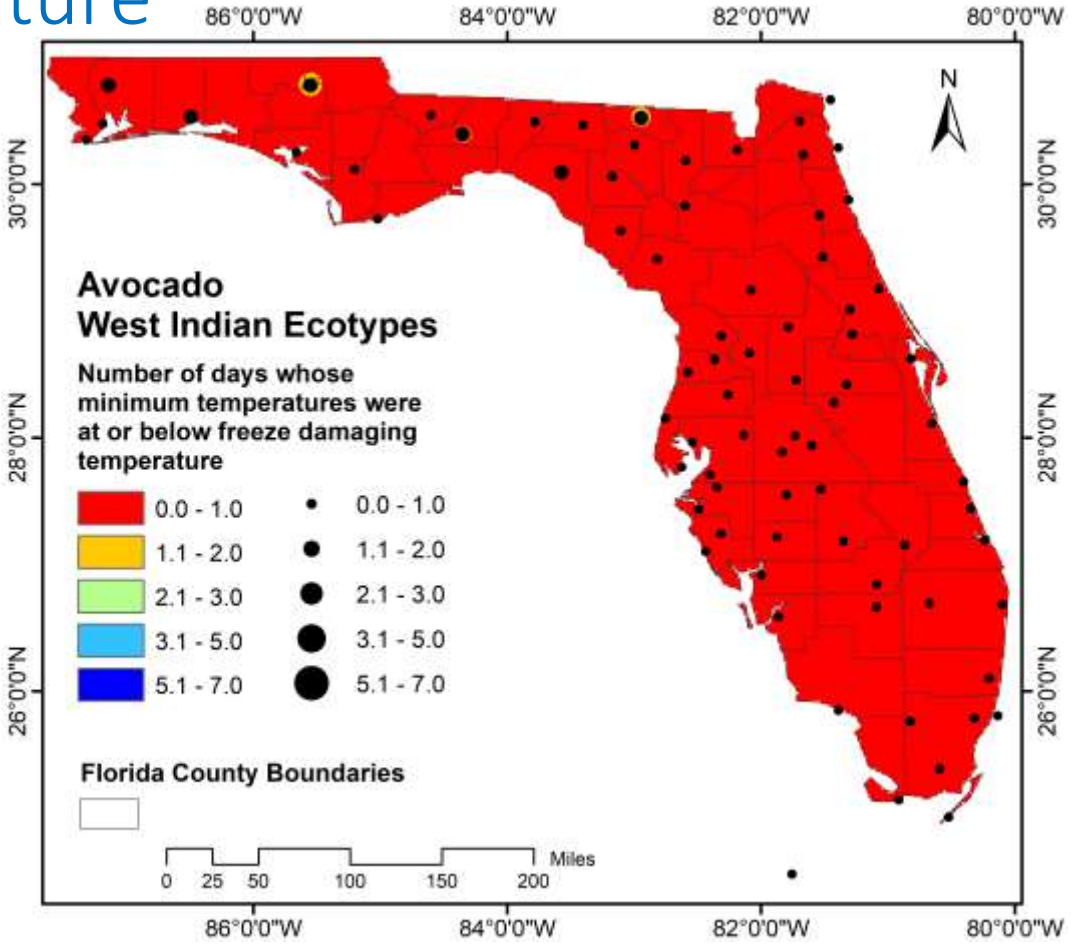
Areas with potential freeze damage

How many days did we have minimum temperatures that were at or below freeze damaging temperature?

Past



Future



Temperatures for flowering

Requires or greatly benefits from cool temperatures – leads to flower induction

- Annona – and/or drought
- Avocado - beneficial
- Longan – required (natural bloom)
- Lychee - required
- Mango - beneficial
- Pineapple (when fully grown plant)

Does not benefit from cool temperature exposure

- Banana
- Canistel
- Carambola
- Guava
- Jackfruit
- Mamey sapote
- Papaya
- Passionfruit
- Sapodilla

Avocado *(Guatemalan, Mexican and GxM hybrids)* ~4,993 acres

Attributes

- Some cultivars tolerate temperatures down to mid-20s
- May be pruned to maintain small stature, <15 ft tall
- Potential market demand (consumption increasing)

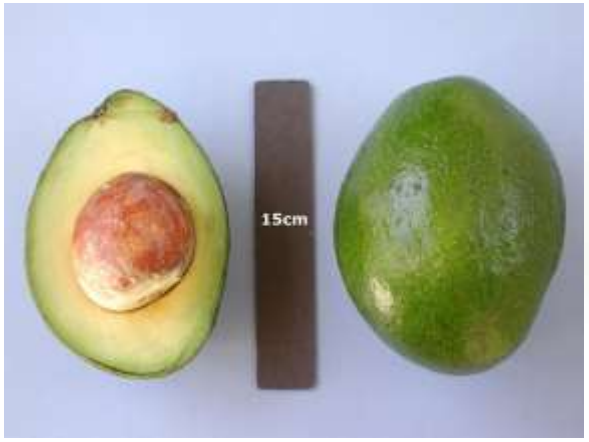
Issues

- Freeze damage
- Must be grown in well-drained soil (phytophthora root rot)
- Laurel wilt an insect-disease complex that kills trees
  - Small ecotype/cultivar differences
  - Ambrosia beetle vectors
  - Tree size, root grafting, effect of light regime

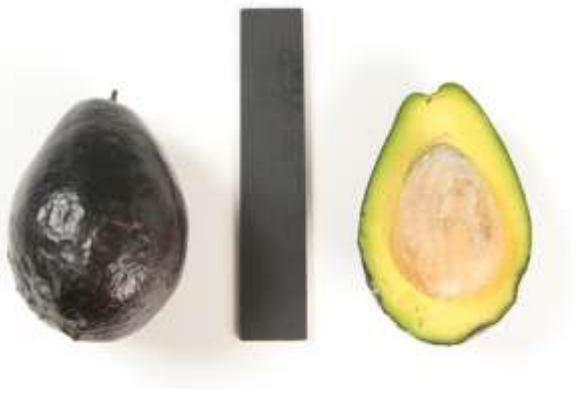
'Carmen Hass'

Cold hardy avocado cultivars

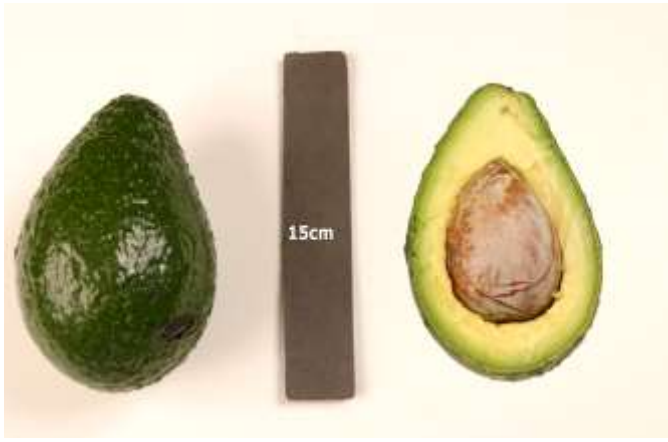
Cold tolerance: L, low; M, moderate: H, high (after exposure to ~24-32°F)



‘Monroe’ (GWI) M

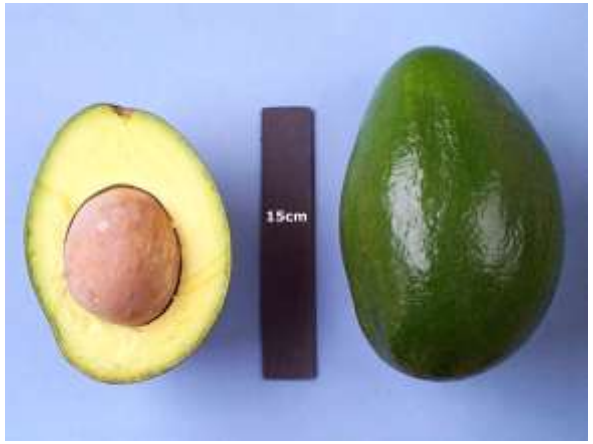


‘Brogdon’ (H) M-H



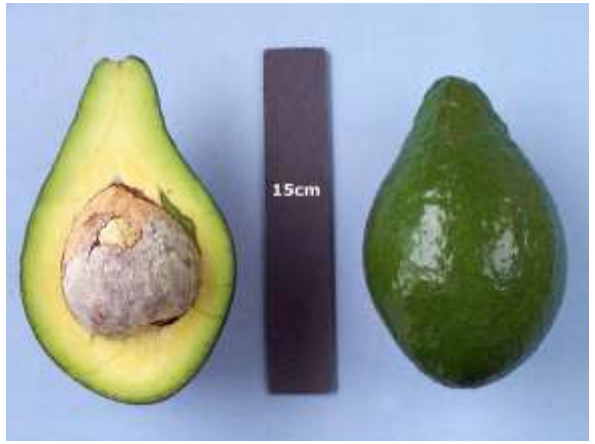
‘Taylor’ (G) M-H

‘Hall’ (GWI) M



‘Choquette’ (GWI) M-H

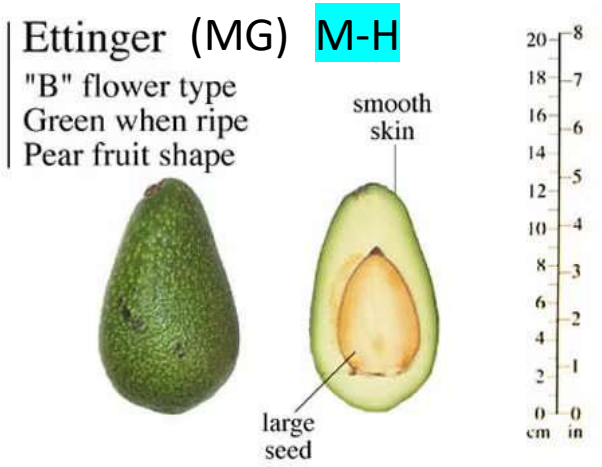
‘Tonnage’ (G) M

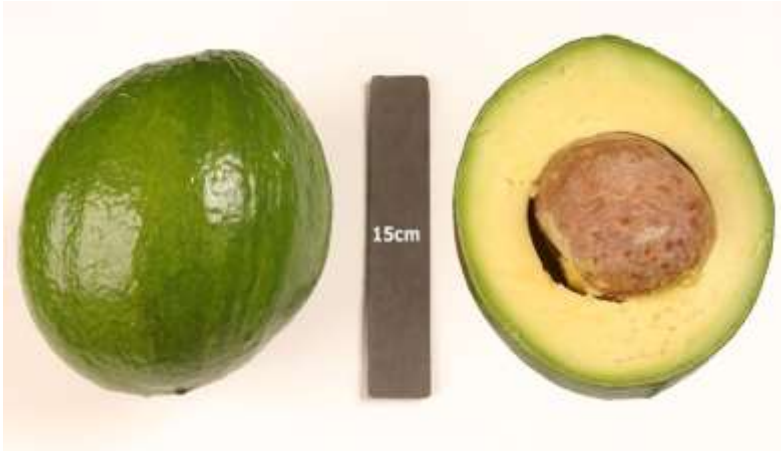


‘Lula’ (GWI) M

‘Reed’ (G) L

Cold hardy avocado cultivars





‘Marcus Pumpkin’ (G) M-H

Cold tolerance: L, low; M, moderate: H, high (after exposure to ~24-30°F)

‘Booth 8’ (GWI) M-H

‘Mexicola’ (M) M-H

‘Pancho’ (M) M-H

‘Winter Mexican’ (MWI) M-H

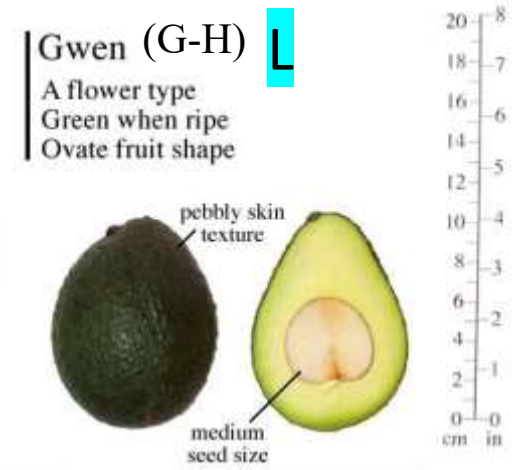
California selections

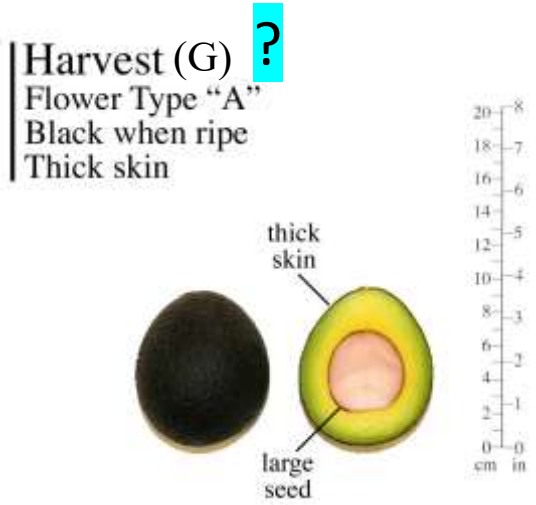
Cold tolerance: L, low; M, moderate: H, high (after exposure to ~30°F)

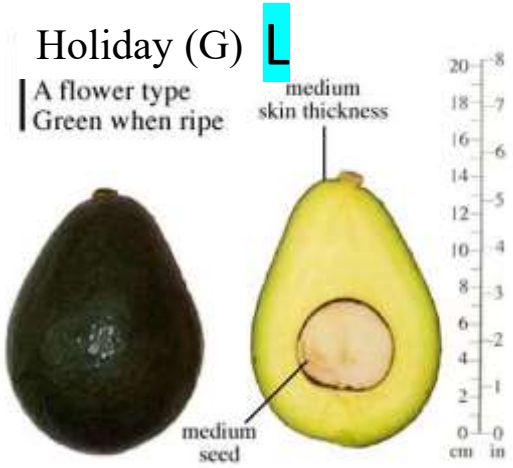
'Carmen Hass' (GM) M

'GEM' (G-H) L

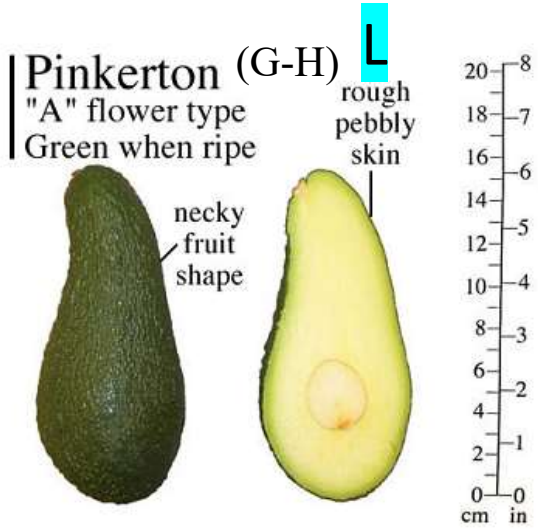
'Hass' (GM) L







'Lamb Hass' (H) L



Phytophthora root rot and laurel wilt

Laurel Wilt (LW)

So far, no tolerant scions or rootstocks have been identified

Phytophthora root rot (PRR)

Tolerant clonal rootstocks have been identified but, not used in Florida so far

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Lychee *(Litchi chinensis)*

~977 acres

Attributes

- Cold tolerance to ~24-25°F
- Excellent fruit
- Numerous cultivars and potential niche markets

Issues

- Unreliable cropping – requires exposure to chilling temperatures (<59°F to 33°F)
- Some insect and disease problems
  - Lychee erinose mite
- Off-shore competition

'Anne Wong'

'Emperor'

'Mauritius'

'Hak Ip'

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Lychee issues

Chilling requirement

- Trees need to be “dormant” for 3 to 12 weeks
- During that time, exposed to temperatures <59°F. If temperatures reach 68°F chilling hours are decreased
- Important to prune after harvest, eliminate/limit N fertilization always, eliminate irrigation after harvest, irrigate from flowering to harvest

Lychee erinose mite (LEM)

- Microscopic
- Spread by wind and contact
- Debilitates trees and production
- Control
  - Current timed, repeated prophylactic sulfur sprays
  - Future – registration of alternatives in progress
  - Limit vegetative growth flushes
  - Synchronize and protect 1-2 flushes only

Longan *(Dimocarpus longan)*

~1,147 acres

Attributes

- Cold tolerance to 26-28°F
- Off-season fruit production possible
- A number of cultivars to choose from – potential niches

Problems

- Unreliable “natural” cropping
  - However, may be induced to flower
- Some insect pests (not LEM)
- Off-shore competition is increasing

‘Kohala’

Longan issues

Fruit thinning and cultural mngt

- Critical to improve fruit size
- Labor intensive
- Critical trees are well fertilized with K and irrigated from flowering through harvest

Over production

- Critical crop load is reduced/fruit thinning
- Large/excessive crop loads result in tree decline, stem/branch death, tree collapse/death

Mango *(Mangifera indica)*

~3,644 acres

Attributes

- Large number of cultivars
- Diverse niche markets (increasing)
- Cold tolerance to 25-30°F

Issues

- Potential freeze – damage, death
- Chilling injury to flowers eliminating fruit set and reducing production
- Fruit disease issues
  - Anthracnose – fungicides registered
  - Bacterial black spot – not well understood
- Off-shore competition (depends upon market)


'Southern Blush'

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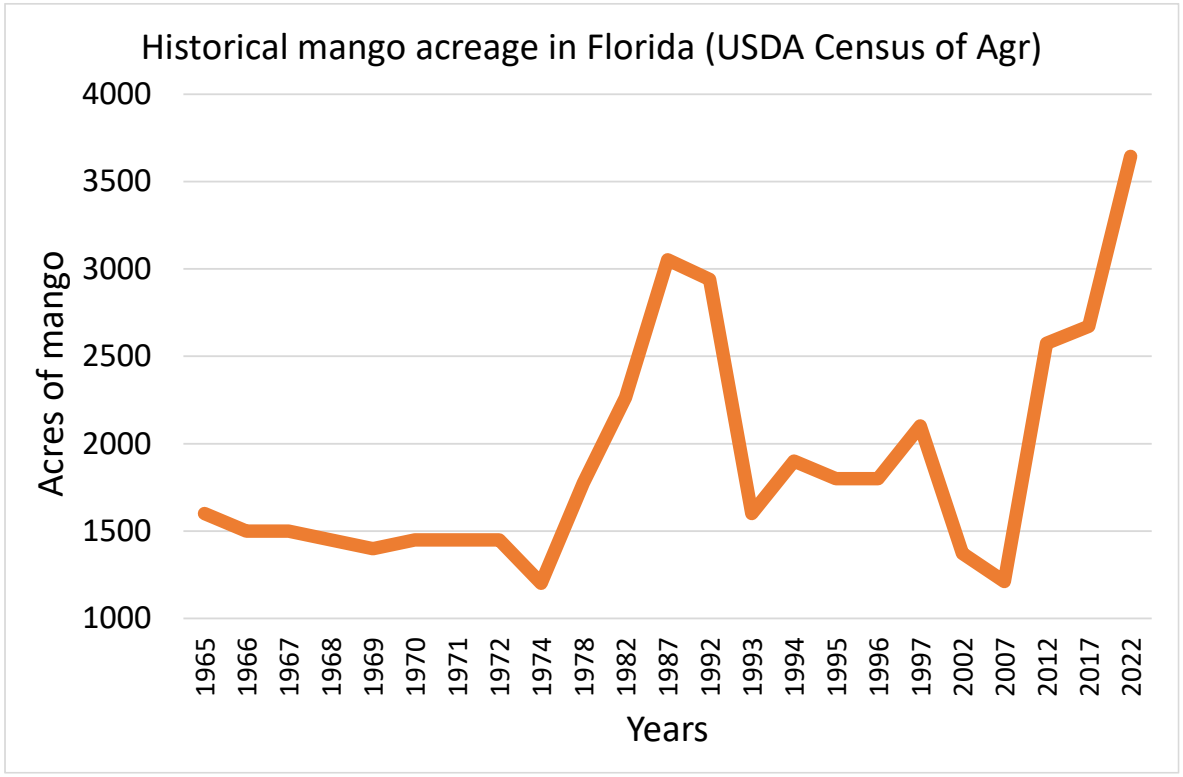
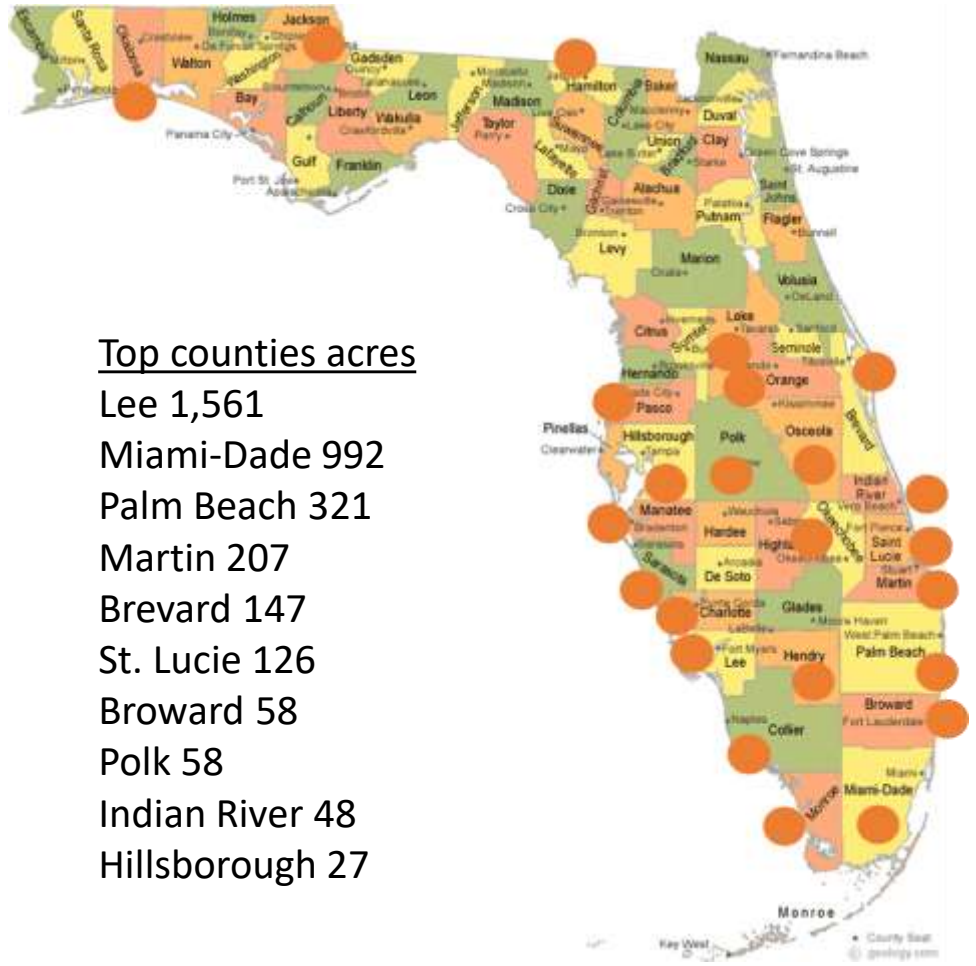
Florida mango production



Florida currently has ~3,644 acres of commercial mango production (USDA Census of Ag, 2022), about 1,103 commercial groves, in 23 counties; estimated value of $20.5 million annually (Blare et al., 2022)



<u>Top counties acres</u>
Lee 1,561
Miami-Dade 992
Palm Beach 321
Martin 207
Brevard 147
St. Lucie 126
Broward 58
Polk 58
Indian River 48
Hillsborough 27

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Mango (*Mangifera indica*) – environmental parameters

Optimum growing temperature range (°F)	Freeze damage range (°F) for mature trees	Heat damage range (°F)	Comments
75-86	~25	>104	Late frost/freeze
Sensitivity to constant winds	Flood tolerance	Plant salinity tolerance	Drought tolerance
Moderately intolerant	Moderately tolerant to tolerant	Intolerant-moderately tolerant*	Tolerant

- *, rootstocks may provide some tolerance
- Comments: Temperatures in mid-to-low 40°Fs or lower during bloom may reduce fruit set.
- Bloom highly susceptible to powdery mildew (cool, dry weather) and anthracnose (wet, warm weather).
- Heat damage – sunburn fruit, accelerated maturity.

Factors that have enhanced/changed the Florida mango industry going forward

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- *Demand for a diversity of superior aroma and flavored mangos*
- *Climate change enabling expansion of mango growing into south-central Florida*
- *Promotion of mango consumption - festivals*
- *Marketing strategies – direct marketing, online sales*

Taking advantage
Advantages to locally grown mangos

- *Superior freshness and quality*
- *Wonderful diversity of varieties (flavors, colors, aromas)*
- *Relatively long season (April/May – September)*
- *No quarantine treatments – hot water, irradiation*
- *Supports local agriculture, family farms*

Common mangos – international trade, western hemisphere

Florida has a long history of mango selection and testing and promoting new mango cultivars and selections and once mainly grew and marketed

'Haden'

'Tommy Atkins'

'Kent'

'Keitt'

'Palmer'

'Edward'

'Irwin'

'Springfels'

'Nam Doc Mai'

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Examples of re-use, revival of “old-time” cultivars

Southern Blush

Nam Doc Mai

Valencia Pride

Glenn

Rosigold

Cogshall

Early Gold

Alfonso

Golden Lippens

Carrie

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The turn-around – significant events

Gary Zill, Zill High Performance Plants
Collection, breeding, selection, release

https://www.youtube.com/watch?v=h-sk2X1LSAM

Photo credits: Chris Wenzel, Jonathan Crane

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Cotton Candy

Fruit Punch

Harvest Moon

Lemon Zest

Orange Essence

Orange Sherbert

Sweet Tart

Venus

Phoenix

Fruit Cocktail[1]

CeciLove[1]

Butter Cream[2]

P-22[1]

Coconut Cream[1]

Giselle[1]

Honey Kiss[1]

Little Gem[2]

M-4[1]

Karen Michele[1]

Piña Colada[3]

Pineapple Pleasure[1]

Super Alphonso[1]

Sugar Loaf[1]

Super Julie[1]

Sunrise[1]

Ugly Betty[2]

1, Photo credit Tropical Acres Farms; 2, Miami Fruit.org; 3, Tampa Tropical Asian Nursery

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Educational/promotional events

FAIRCHILD
Mango Festival

PRESTON B. BIRD AND MARY HEINLEIN
FRUIT&SPICE
PARK

Saturday, June 28, 2025 | 9:00 AM

Mango Mania 2025

The Tropical Fruit & Vegetable Society of the Redland is partnering with the Fruit & Spice Park to present this much-loved event presented by TFVSR for over 30 years!

Florida Mango Festival
June 29, 2025

Join us for the mango event of the year in West Palm Beach, Florida! Discover the vibrant flavors of mangos while we showcase Florida's finest small, independent farms and their exceptional fruit.

GREATER PINE ISLAND
CHAMBER OF COMMERCE

MANGOMANIA 2025

MANGOMANIA
PINE ISLAND'S TROPICAL FRUIT FAIR

DATE: July 12, 2025

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Online and direct marketing

Social media

Fruit stands

FruitScapes, LLC
Fruit Tree Nursery & Fruit Market
12870 Stringfellow Rd. • Bokeelia, FL 33922

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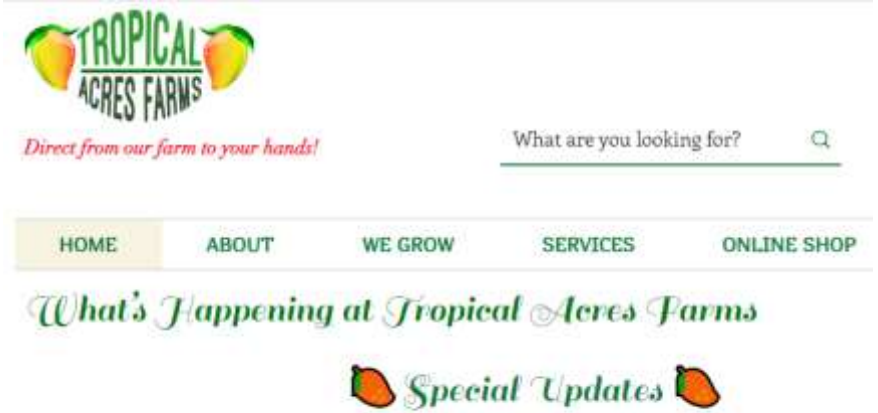
Diverse sales



Conclusions - convergence

- Cultivar collection, evaluation, development and selection
  - Production of diverse mango cultivars and selection
  - Established producers and entrepreneurs see a business opportunity
- Promotion and education
- Increased ethnic diversification of US population
- Increased availability of mango fruit in the market
- Multi-media's outreach, information and dissemination
- Ease of purchasing – in-person and online/mail-order

As we warm, crops with potential for expansion

- Annona – cherimoya, atemoya, sugar apple, custard apple
- Abiu
- Breadfruit?
- Carambola
- Pink guava
- Jackfruit
- Mamey sapote
- Rambutan?
- Sapodilla
- Wax jambu (java apple)

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Potential – protected ag

- Guanabana
- Passionfruit
- Papaya

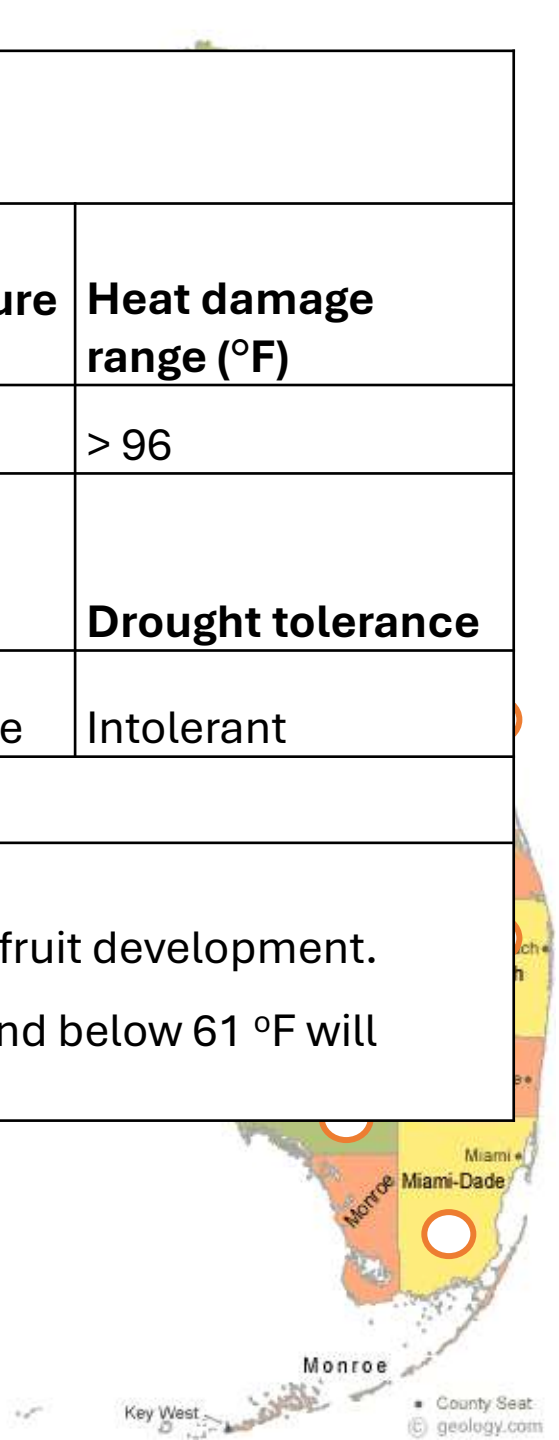
Papaya (*Carica papaya*)

Crop	Optimum growing temperature range (°F)	Freeze damage range (°F) for mature trees	Heat damage range (°F)
Papaya	77-91	<30	> 96
Sensitivity to constant winds	**Flood tolerance**	**Plant and/or rootstock salinity tolerance**	**Drought tolerance**
Intolerant, sensitive	Intolerant	moderate tolerance	Intolerant

Comments

- Needs at least 73 °F for six months for normal flowering and fruit development.
- Stops growing at and below 54 °F. Chilling temperatures at and below 61 °F will reduce growth and production.

Currently Florida has ~148 acres



Annona – sugar apple (*Annona squamosa*), atemoya (*A. cherimola* x A. *squamosa*), guanábana (*A. muricata*)

Crop	Optimum growing temperature range (°F)	Freeze damage range (°F) for mature trees	Heat damage range (°F)
Sugar apple	75-86	28-29	>100
Guanabana	68-86	30-32	>100
Atemoya	65-86	<28	>100

Crop	Sensitivity to constant winds	Flood tolerance	Plant and/or rootstock saline soil and/or water tolerance	Drought tolerance
Sugar apple	Intolerant	Intolerant, rootstock dependent	Sensitive to intolerant	Tolerant
Guanabana	Intolerant	Moderately tolerant	Not reported	Tolerant
Atemoya	Intolerant	Intolerant, rootstock dependent	Not reported	Tolerant

Comments

- More than a few days of temperatures below ~50 °F result in chilling injury.
- Flood tolerance is moderately rootstock dependent.
- Atemoya is reported as drought tolerant but may result in leaf abscission and reduce growth ar yields. Irrigation is common practice.

Guestimated 20 acres guanabana and 80 acres sugar apple; misc. 30 acres

'Possum Purple'

Passionfruit (*Passiflora edulis* forms and hybrids)

Crop	Optimum growing temperature range (°F)	Freeze range (°F) for mature trees	Heat damage range (°F)
Passionfruit	68-86	<28-32	>91
Sensitivity to constant winds	**Flood tolerance**	**Plant and/or rootstock salinity tolerance**	**Drought tolerance**
Intolerant, sensitive	Slightly tolerant to intolerant	Intolerant	Moderately tolerant

Comments

- Tolerance to flooding is affected by passionfruit species, soil and climactic factors, and presence of disease pathogens in the soil.
- Vines may tolerate ~4 days of drought; if more, then stops growth, flowering, and fruit set and may drop flower buds resulting in reduced yields.
- Heat damage may reduce or stop vine growth, cause flower bud or flower drop, and result in reduced production.

Currently Florida has ~150 acres with new and planned acreage in Central Florida

University of Florida Institute of Food and Agricultural Sciences

- EXTENSION electronic publications https://edis.ifas.ufl.edu
- Mango Science https://mango.ifas.ufl.edu/
- Videos and website links on tropical fruit production https://trec.ifas.ufl.edu/people/jonathan-crane/

QUESTIONS

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University of Florida/IFAS

- On-line publications, EDIS

http://edis.ifas.ufl.edu

- New Growers workshop series

https://trec.ifas.ufl.edu/people/jonathan-crane/

- YouTube – IFAS Video
- YouTube – UF/IFAS Solutions
- YouTube – Jonathan Crane

- AgroClimate http://agroclimate.org/
- NOAA https://www.noaa.gov/
- NWS https://www.weather.gov/
- FAWN https://fawn.ifas.ufl.edu/

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