Tropical Fruit

-Pests and Diseases-

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BASMI Pesticide Training

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UNIVERSITY of FLORIDA

PALM BEACH COUNTY FLORIDA

Today's Topics

- Florida Tropical Fruit
- Major Pests Diseases
  - **Citrus**
  - **Avocado**
  - **Papaya**
  - **Pineapple**
  - **Mango**
  - **Banana**
  - **Guava**
  - **Sugar Apple**

Sunny South

FLORIDA

Temperate
Sub-Tropical
Tropical

Palm Beach County

Hardiness Zone
10a

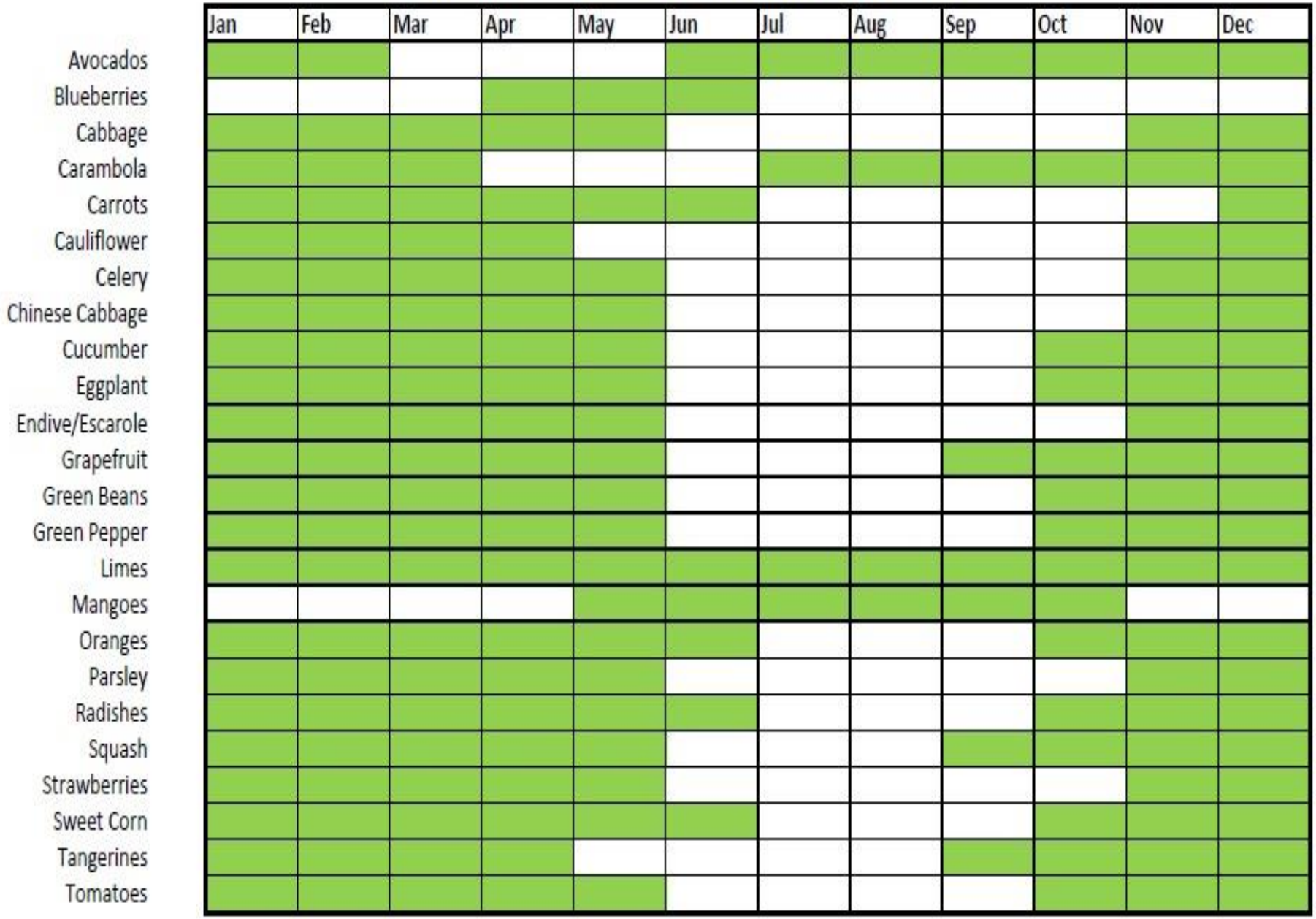
Micro-Climates
9b to 10b

Chilling Hours
75 to 150 hours below 45°

Rainfall
50 to 60 inches

Gulf Stream
Warmer temperatures

Florida's Local Seasonal Growth Chart



South Florida Fruit Options

Temperate

- Apple
- Blackberry
- Blueberry
- Jujube
- Figs
- Grapes
- Peaches
- Nectarines
- Pears
- Pecan
- Persimmon
- Plums
- Pomegranate
- Raspberry

Subtropical

- Atemoya
- Avocado
- Banana
- Caimito (Star Apple)
- Canistel
- Carambola
- Coconut palm
- Coffee
- Dragon Fruit (Pitaya)
- Guava
- Jaboticaba
- Jak-fruit
- Jujube
- Longan
- Loquat
- Lychee
- Macadamia Nut
- Mango
- Pineapple
- Sapodilla
- White sapote

Tropical

- Avocado
- Banana
- Barbados cherry
- Black sapote
- Caimito (Star Apple)
- Canistel
- Citrus
- Cocoa
- Coconut palm
- Coffee
- Dragon Fruit (Pitaya)
- Guava
- Jaboticaba
- Jak-fruit
- Jujube
- Longan
- Mamey sapote
- Mango
- Monstera
- Papaya
- Passion fruit
- Pineapple
- Sapodilla
- Sugar apple
- White sapote

- Seasonality of south Florida fruit -

Yellow = limited availability **Pink = peak season**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Annona												
Avocado												
Banana												
Star Apple												
Pitaya												
Guava												
Jackfruit												
Longan												
Lychee												
Mamey												
Mango												
Papaya												
Passion Fruit												
Sapodilla												
Starfruit												
Wax Jambu												

Fruit trees for 15 or 25 gallon pots

- Avocado
- Banana
- Barbados Cherry
- Blueberry
- Carambola
- Dragon Fruit
- Fig
- Guava
- Jaboticaba
- Carambola
- Citrus
- Miracle Fruit
- Monstera
- Papaya
- Passion Fruit
- Pineapple
- Sapodilla
- Sugar Apple
- Mango
  - *Carrie, Cogshall, Fairchild, Glenn, Irwin, Julie, Nam Doc Mai*

UF IFAS Extension UNIVERSITY of FLORIDA

PDEC Program Development & Evaluation Center

IMPROVING FLORIDA'S TROPICAL FRUIT INDUSTRY

Florida growers face a host of complex issues, including

- rising land prices
- unpredictable weather/climate variability
- labor concerns
- competition from foreign markets
- new food safety regulations
- a steady stream of new pests and diseases

UF/IFAS Extension provides research and science-based educational programs to tropical fruit growers, grove managers, and industry representatives in South Florida to help increase the industry's sustainability, profitability, and competiveness.

Florida's Tropical Fruit Growers

25
different fruit crops are grown in South Florida, including avocados, mango, lychee, and longans

1,600
commercial tropical fruit growers

$1.8 billion
value to the state

UF/IFAS Extension Tropical Fruit Program

67%
of growers work with tropical fruit only part-time or have limited horticultural backgrounds.

437
tropical fruit growers in Miami-Dade County attended 16 UF/IFAS Extension workshops on horticultural practices and tropical fruit production in 2015.

77%
reported practice changes, including improved pruning and planting techniques, choosing better cultivars, and better grafting practices.

$2,300
reported average income gain – a potential gain of $775,000 for all attendees.

Battling Pests and Diseases

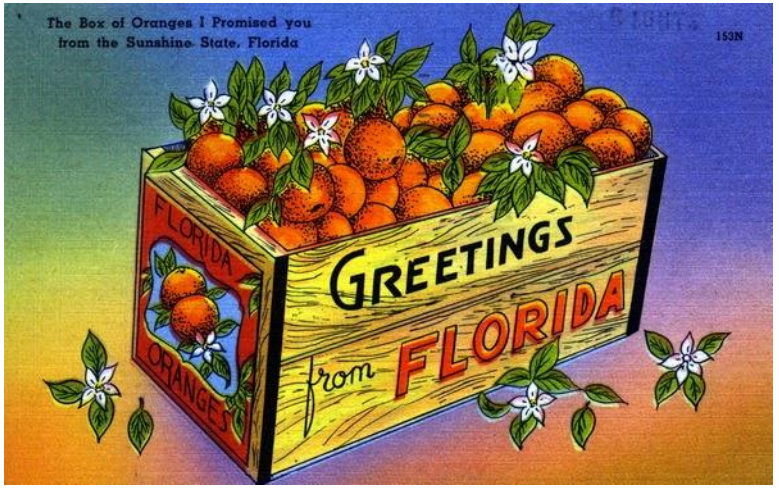
11,000+
avocado trees have been killed or removed in the past 5 years as a result of LAUREL WILT DISEASE. UF/IFAS educators and researchers offer training and services that have significantly reduced the spread of this disease.

$4.1 million
in tropical fruit losses due to ORIENTAL FRUIT FLY in 2015-2016. Quick and decisive action by UF/IFAS, USDA and FDACS contained the outbreak, potentially saving growers a further $19 million in losses.

Florida Citrus #1 in USA

-3rd in the world (Brazil then China)-

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Oranges												
Navels	✓	✓								✓	✓	✓
Lee										✓	✓	✓
Temples		✓	✓									
Juice Oranges												
Valencia	✓		✓	✓						✓	✓	✓
Tangerines												
Fallglo									✓	✓	✓	
Sunburst									✓	✓	✓	✓
SolZest	✓										✓	✓
Honey		✓	✓									
Grapefruit												
Ruby Red	✓	✓	✓	✓	✓						✓	✓
White	✓	✓	✓	✓							✓	✓
Tangelos												
Honeybells	✓											



Citrus Greening Disease

No cure available!

2005 = Arrives in FL

2012 = 43% of 62.5 Mil trees

2016 = 90% acreage ; 80% trees

Management:

Enhanced Nutrition via

- Foliar Sprays
- Stabilizes Production
- Improves Appearance
- Root Improvement

Asian Citrus Psyllid

- *Diaphorina citri*
  - Vectors the bacterial pathogen causing HLB
    - HLB = huanglongbing = citrus greening
- Can be difficult to control.
- Attacks new growth, damaged leaves persist.
  - Oil on new leaves
  - Wait 10 days and spray again
  - Need a protectant until leaf hardens
- Insecticides:
  - chlorpyriphos, clothianidin, dimethoate, fenpropathrin, imidacloprid, phosmet, spinetoram, spirotetramat, sulfoxaflor, thiamethoxam, cypermethrin

"The label is the law."

- **Pesticide labels must be followed by all.**
  - **For personal and environmental safety.**
  - **Even by dooryard & backyard growers.**
  - **Includes – reentry (REI) & preharvest (PHI) intervals.**
- **Crop & application site must be on label.**
  - **Turf vs. Ornamentals vs. Edible Crops**
  - **Specific fruits and vegetables.**

Citrus Leaf Miner

- *Phyllocnistis citrella*
  - A moth, not a fly.
- Can be difficult to control.
- Attacks new growth, damaged leaves persist.
  - Oil on new leaves
  - Wait 10 days and spray again
  - Need a protectant until leaf hardens
- Insecticides:
  - abamectin, acephate, azadirachtin, bifenthrin, permethrin, neonicotinoids

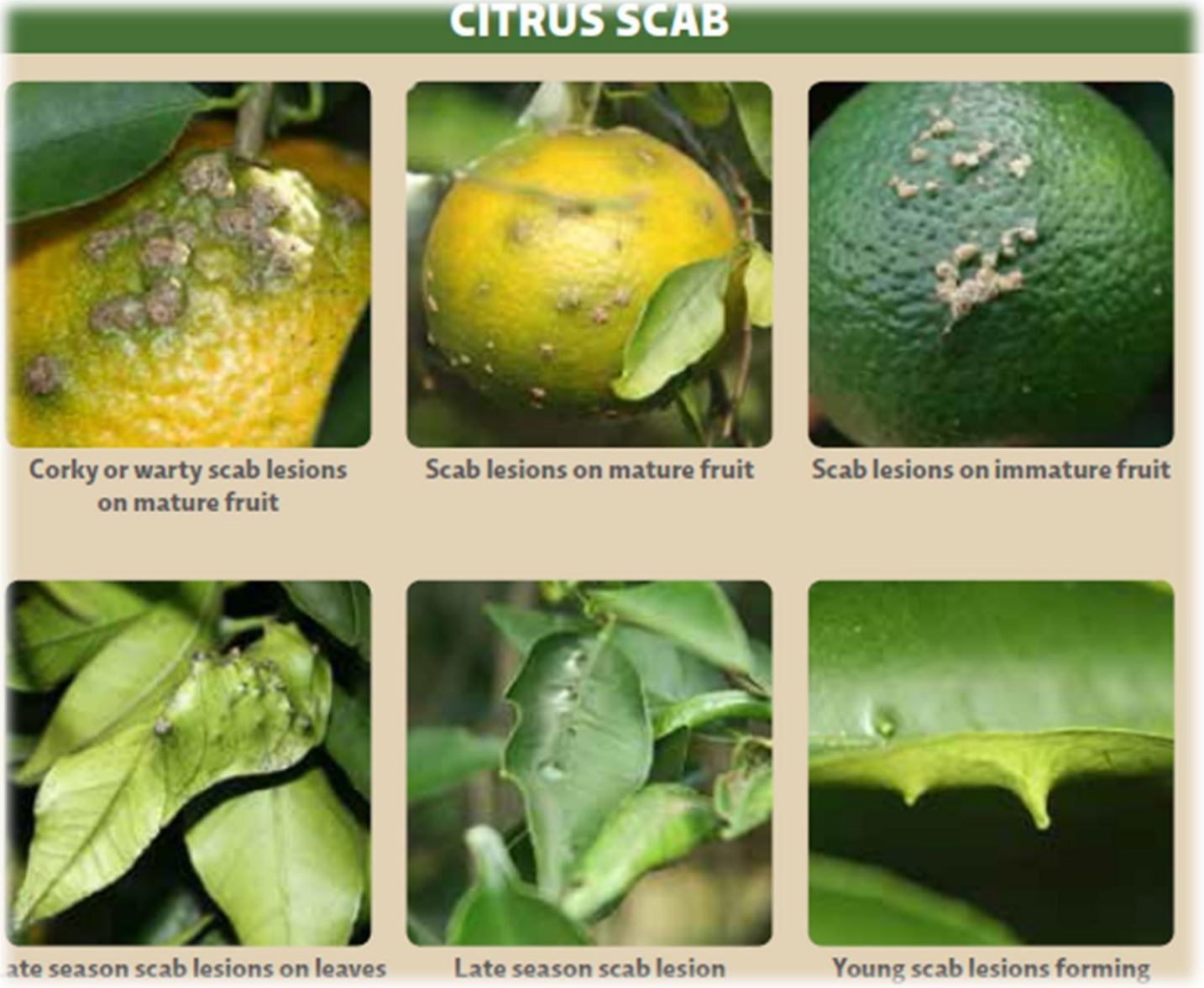
Elsinoë fawcettii

Leaves:

- Finger-like lesions with a tan-to-gray pustule at the tip.

Fruit:

- Start slightly raised, pink to brown lesions developing to wart-like that can crack.
- Color changes yellow brown to dark gray.



Varieties Affected: Grapefruit, Temples, Murcotts, Tangelos and other Tangerines.

Management:

Start with clean nursery trees; prune out heavily infected sections of tree; use moderately vigorous rootstock; no over-head watering; copper fungicides

Mycosphaerella citri

Leaves:

- Initial yellow mottle pattern with red to brown blisters on underside.
- Then lesions darken brown and yellow disappears.

Fruit:

- Pink specks on rind then brown to or black 3-6 months later.

GREASY SPOT

Early greasy spot rind blotch on grapefruit

Greasy spot rind blotch on mature grapefruit

Greasy spot rind blotch on mature grapefruit

Young greasy spot lesions

Older greasy spot lesions

Varieties Affected: All citrus but especially grapefruit, Pineapples, Hamlins and tangelos.

Management: Remove dead leaves from around tree; copper fungicide or oil.

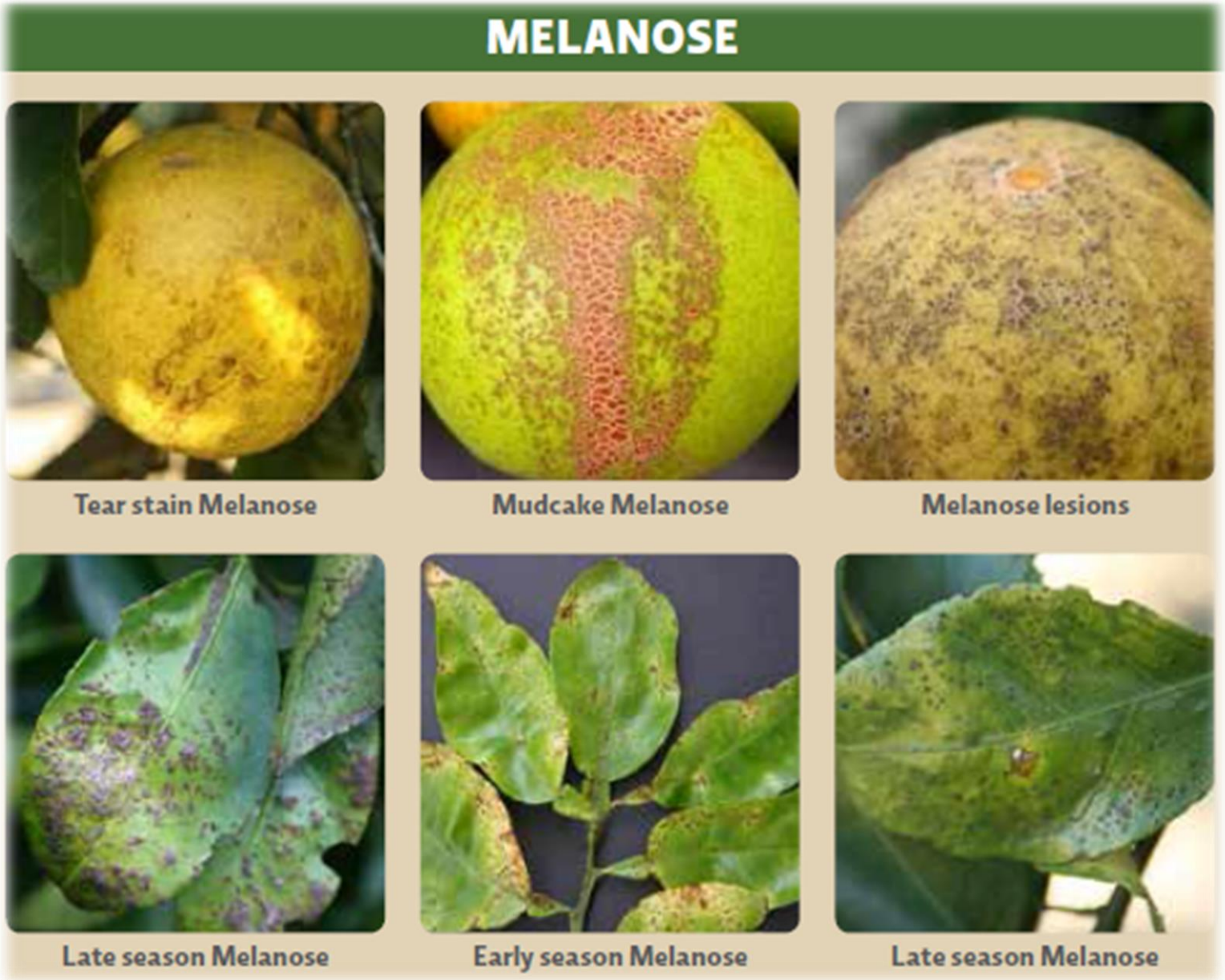
Diaporthe citri

Symptoms:

- Small red to brown spots with yellow halos disappearing in time.
- Then raised pustules remain.

Fruit:

- Red to brown, rough lesions.



Varieties: All citrus but grapefruit and lemons are most susceptible.

Management: Prune out as much dead wood as possible; copper fungicides.

Leaf Symptoms:

- Small brown spots with yellow halos.

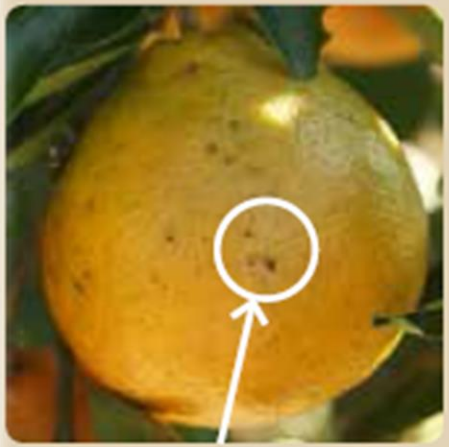
Fruit Symptoms:

- Small dark specks & develop into either large black lesions or corky eruptions may fall off leaving craters.

Varieties Affected:

- Minneola tangelos
- Dancy tangerines
- Murcotts
- Orlando tangelos
- Novas
- Lees
- Sunburst

ALTERNARIA BROWN SPOT



Alternaria lesions on mature fruit

Alternaria lesions on immature fruit

Alternaria lesions and wind scar on mature fruit. Note corky eruptions and craters

Young Alternaria lesion on leaf

Young Alternaria lesions on leaf; Note necrosis following veins

Late season Alternaria lesion on leaf

Management:

Start with clean nursery trees; good air drainage; prune in March; moderately vigorous rootstock; do not over-fertilize or water; no over-head watering; copper fungicides.

Avocado

Persea americana

- Large evergreen tree 30-65 ft.
- Tropical/Subtropical
- Cold Tolerant 18° - 32°
- Very low flood tolerance
  - Plant on a mound or in a well drained soil
  - Even a few days in flooded conditions can kill
- Peak harvest = August/November
- Other Issues
  - Hypersensitivity to flooding
    - Roots suberized, low hydraulic conductivity, few root hairs, and poor water uptake.
      - Prune before Hurricane Season

Fungicides:

- Copper, sulfur, strobilurin, Bacillus, azadirachtin, metalaxyl, fludioxonil,cyprodinil

Avocado Issues:

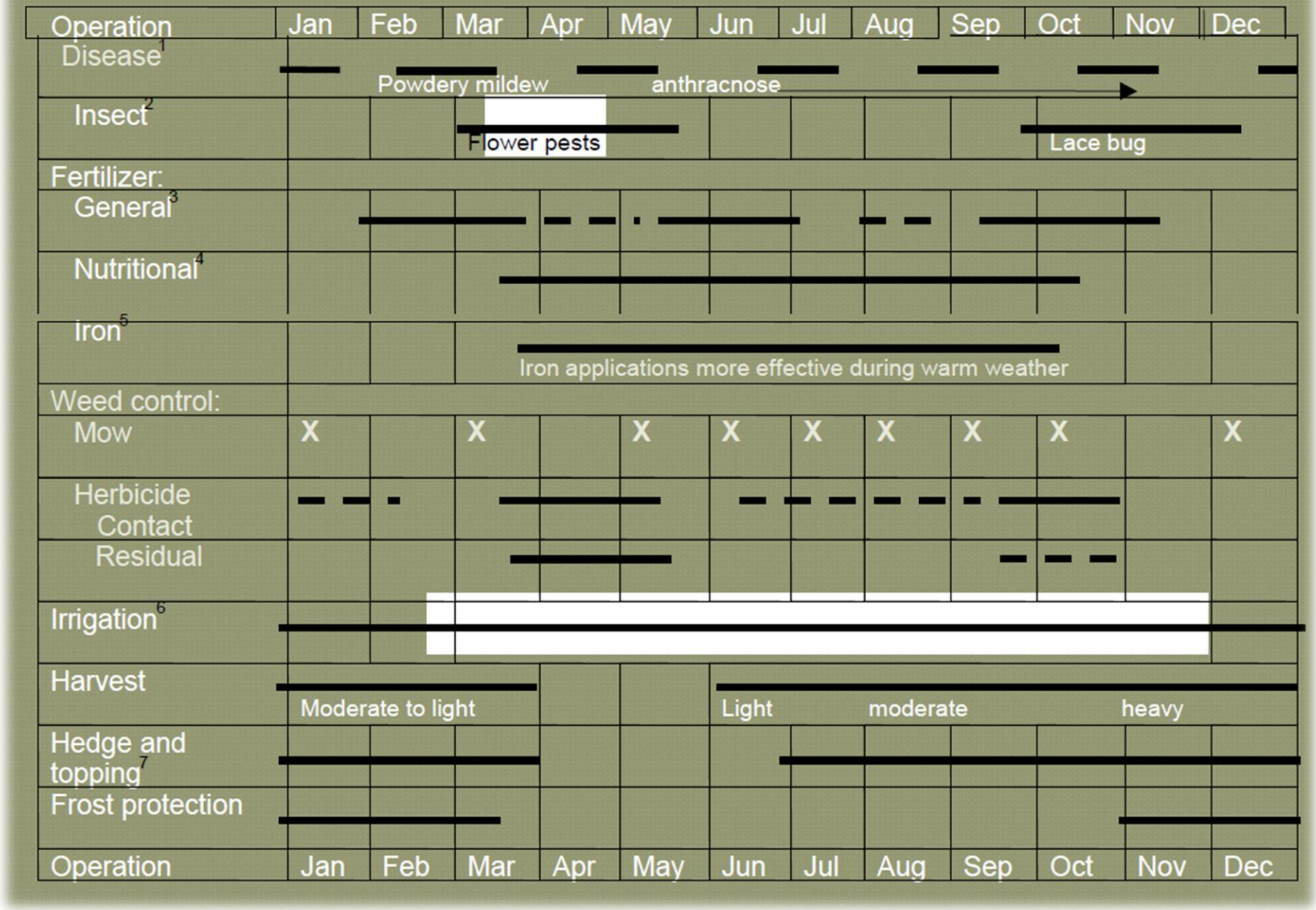
<u>Redbay ambrosia beetle</u> (RAB) = *Xyleborus glabratus*

- <u>Laurel Wilt Pathogen</u> (LW)
  - *Raffaelea lauricola*
- Carries spores of the laurel wilt pathogen as they bore into trees.

Laurel wilt key points

- Insect vectored disease.
- Pathogen is a fungus.
- Redbay ambrosia beetle and others can transmit.
- Fungus can move to near by avocado via root to root contact.
- Detect and remove symptomatic trees early.
- Laurel wilt does <u>not</u> infest other fruit trees.
- RAB movement
  - RAB infested wood
    - Firewood
    - Illegal dumping
    - Infested mulch, wood
  - Other Lauraceae trees
    - Red Bay, Swamp Bay,
- Prevention & early detection is essential.
- Fungicides are very $$.
  - Not very effective.

Production practices for Florida avocados



Avocado

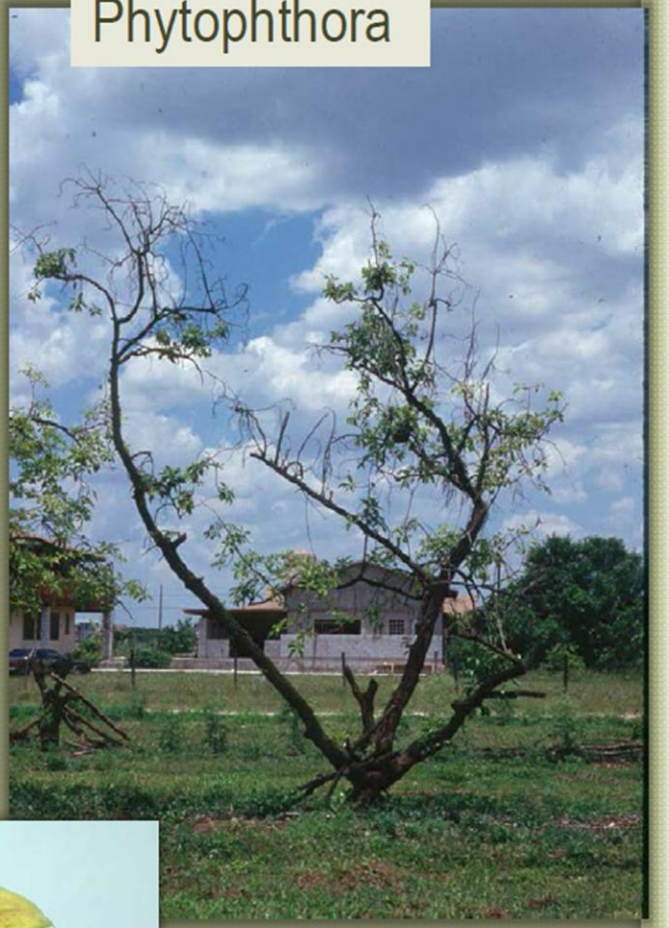
Major diseases and insects in Florida

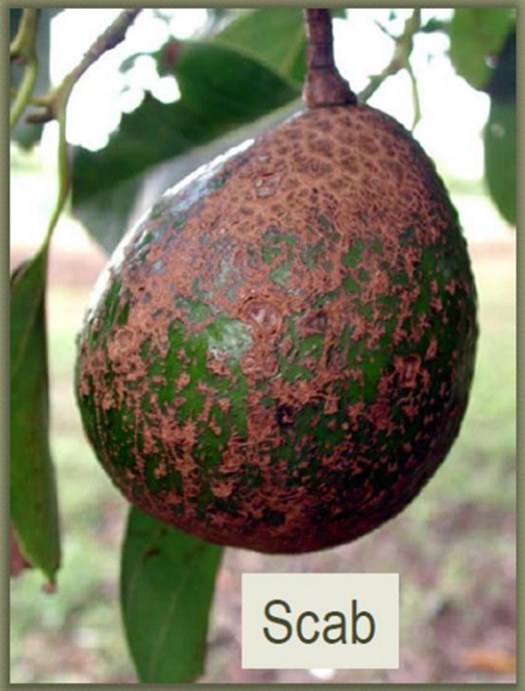
- Laurel wilt
- Anthracnose – periodic fungicide applications
- Avocado scab – several fungicide applications during fruit set/early fruit development
- Powdery mildew – 1-2 fungicide applications
- Phytophthora root rot – plant in nonflood areas and fungicide applications
- Sun-blotch viroid – destroy infected trees
- Redbay ambrosia beetle
- Other ambrosia beetle spp.
- Avocado lace bug
- Flower thrips and mirids
- Avocado looper
- Avocado red mite
- Red-banded thrips
- Allow “natural” predators to work, use least disruptive materials, scout/monitor grove continuously and apply insecticide as needed

Red algae & wind

Anthracnose

Phytophthora





Scab

Sun blotch

Avocado lace bug

Avocado leaf roller and damage

Thrip damage on fruit

Sunburn

CHILE ‘HASS’

DOMINICAN REPUBLIC ‘CARLA’

Papaya

Tropical /Sub-Tropical:

- *Carica papaya*
- A fast growing herb (30 feet)
- Male, Female or hermaphroditic (bisexual)
- Short-lived (7 to 10 years),
- Low Maintenance

Papaya fertilizer & cultural practices

Month	Times per month	Amount per tree per application (lbs)	Number of nutritional sprays per 4 months	Number of iron applications per 6 months	Iron chelate drenches (oz/tree/application)
1	2	1/4	1	1	1/4
2	2	1/4–1/2	1	1	1/4
3	2	1/4–1/2	1	1	1/4
4–7	2	1/2–3/4	1	1	1/2
8	1	3/4–1	1–2	1	1/2
9	1	1	1–2	1	1/2
10	1	1	1	1	1
12+	1	1-2	1	1	1

Operation	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Disease control[1]	Monitor plants for diseases year-round. Treat plants showing signs of leaf diseases promptly.											
Insect control[2]	Monitor plants for insect pests, inspecting the lower surface of leaves for mites, whitefly, and webworms. Bag young fruit to prevent papaya fruit fly attack.											
Fertilizer	Throughout the year apply small amounts of fertilizer frequently.											
General[3]	Apply NPK		Apply NPK		Apply NPK		Apply NPK		Apply NPK		Apply NPK	
Nutritional[4]			Apply micro-nutrients	Apply micro-nutrients	Apply micro-nutrients		Apply micro-nutrients		Apply micro-nutrients		Apply micro-nutrients	
Iron[5]				Apply iron		Apply iron		Apply iron		Apply iron		
Watering[6]	Water trees more frequently as temperatures increase. Trees grown in well-drained soil that does not hold much water (sands, rock) may be watered at a shorter interval than trees growing in a soil that holds water (sandy loams, loams, muck).											

Papaya Issues

- **Papaya fruit fly**
  - *Toxotrypana curvicauda*
- Lays eggs through the papaya fruit peel into the fruit where larvae feed.
- Adult has long abdomen and yellow and black markings.
  - Very similar wasps.
- Infested fruit fly may show yellow areas and drop.
- Bag small fruit until harvest.

Papaya Issues

- **Papaya whitefly**
  - *Trialeuroides variabilis*
- Causes leaves to drop and reduced fruit production.
- Control includes removing infested leaves and applying appropriate pest control products.

Papaya Issues

- **Two-spotted mite**
  - *Tetranychus urticae*
- May cause defoliation and early leaf drop.
- Symptoms; yellowing then browning of leaf surfaces.
- Control: Soaps, oils, overhead irrigation and labeled miticides.

Fungicides:

- Copper, sulfur, strobilurins, *Bacillus, Streptomyces,* mancozeb, oils, chlorothalonil, fludioxonil, metalaxyl

Papaya Issues

- **Nematodes**
  - *Meloidogyne incognita (RKN)*
  - *Rotylenchulus reniformis*
- Feed on plant roots, causing a decline in vigor and making more plants more susceptible to toppling over.
- Plants in areas with clean soil, avoid areas with known nematode problems.

Viruses

and

Leafspots are primary issues

Fungicides:

- Copper, sulfur, strobilurins, *Bacillus, Streptomyces,* mancozeb, oils, chlorothalonil, fludioxonil, metalaxyl

PINEAPPLE

Tropical:

- *Ananas comosus*
- Herbaceous monocot
- Moderate to High Maintenance
- Drought Tolerant
- Long Fruiting Cycle 18 to 36 mo.

Root pests & diseases:

- Nematodes
- Pythium
- Phytophthora root rot
- Bacterial soft rot

Pineapple Fertilizer Practices

Operation	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Strategy	First 14 to 16 months: Concentrate on growing a vigorous, healthy pineapple plant for the first 14 to 16 months. Fertilize in small amounts frequently (every 6 to 8 weeks) and water during dry periods. After 16 months, induce flowering or allow winter cool period to induce flowering; reduce nitrogen fertilizer rate. Once flowering occurs, continue to fertilize and water plants to enhance fruit growth and quality.											
General dry[1]	Apply NPK mix		Apply NPK mix		Apply NPK mix		Apply NPK mix		Apply NPK mix		Apply NPK mix	
General foliar [1]	Apply NPK foliar mix		Apply NPK foliar mix		Apply NPK foliar mix		Apply NPK foliar mix		Apply NPK foliar mix		Apply NPK foliar mix	
Foliar micronutrients[2]					Apply spray		Apply spray		Apply spray			
Iron applications [3]	Apply iron		Apply iron		Apply iron		Apply iron		Apply iron		Apply iron	
Watering	Water during dry periods lasting more than 6 or 7 days during hot weather and every 10 or 12 days during the cooler winter months.											
Insect control	Monitor for scales and mealybugs. Contact your local County Extension Agent for current control measures.											
Disease control	Monitor for plant decline and diseases. Contact your local County Extension Agent for current control measures.											
Flower forcing			Allow flowering to occur after cool weather or induce flowering now.									

[1] Use either a dry fertilizer mix or foliar mix or alternate, e.g., dry, foliar, dry, foliar, etc.
[2] Use complete micronutrient fertilizer mixes that may contain manganese, zinc, and iron (some mixes may have magnesium).
[3] Apply a foliar mix of iron (ferrous) sulfate or soil drench of chelated iron.

Pineapple Issues

- **Mealybugs**
- May attack the leaves, fruit and lateral, shallow roots.
- Ants commonly "farm“ mealybugs and scales by protecting them from natural predators and moving them to new feeding.
  - Controlling ants will help.
  - Ants will not cross fire ash.

Pineapple Issues

- **Scales**
- Attack leaves
- Use clean soil to start new plants and inspect plants frequently.
- Horticultural soaps and oils work well on these and other piercing-sucking pests.
  - Usually requires repeat applications 5-7 days apart.

Fungicides:

- Sulfur, strobilurins, *Bacillus,* propiconazole, mefenoxam, oils, fludioxonil, metalaxyl,

Mango

Scientific Name:
Mangifera indica

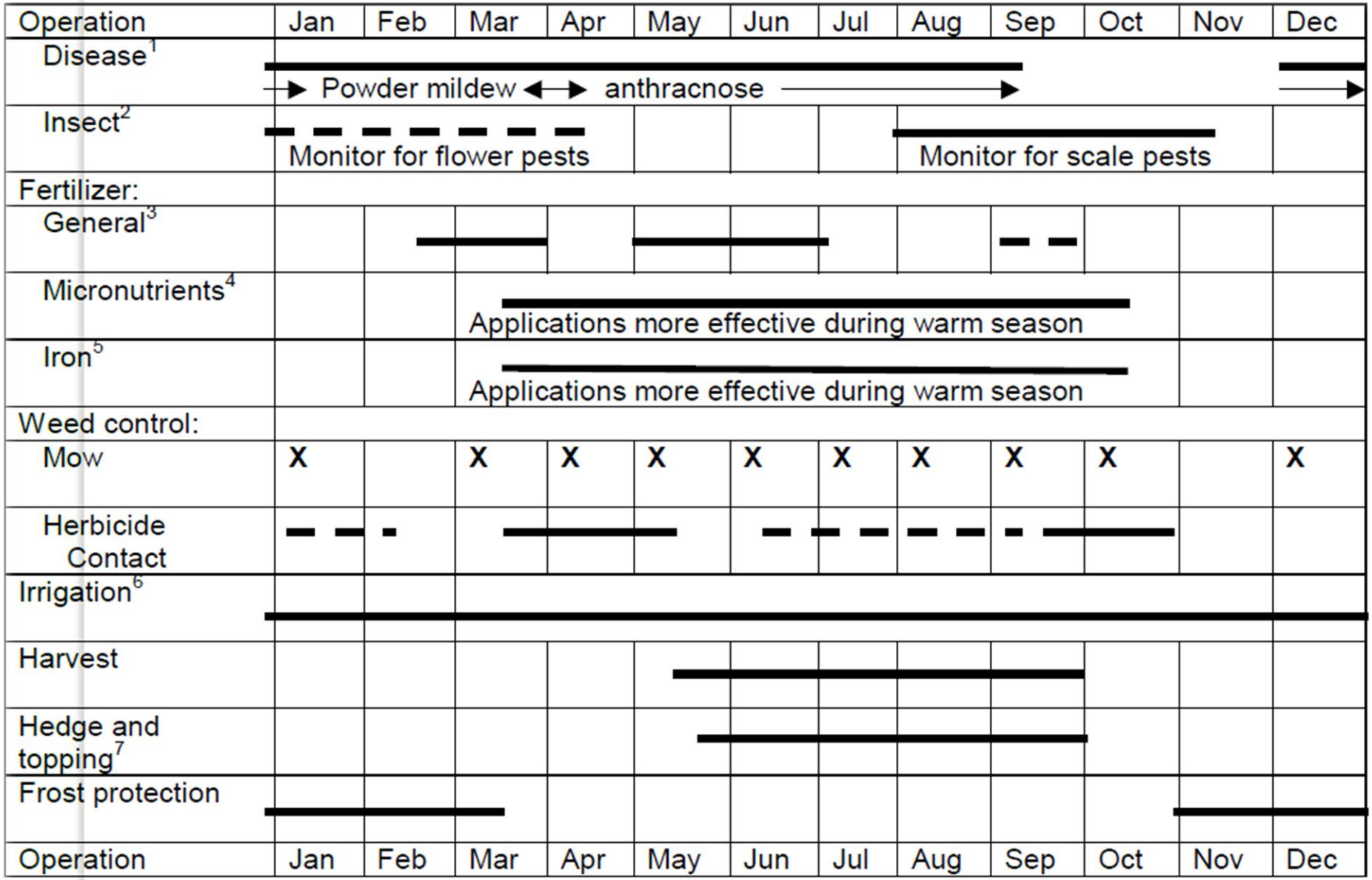
1000 + varieties

Poison Ivy Family

Tropical/Sub-Tropical:

- Medium to Large evergreen tree 25 to 100 ft.
- Low Maintenance
- Drought Tolerant

Mango Production Practices



Major insect pests of mango in Florida

- Flower thrips – scout and apply insecticide as needed.
- Scales – scout and apply insecticide as needed.
- Allow "natural" predators to work, use least disruptive materials, scout/monitor grove continuously.

Flower thrip (*Frakliniella bispinosa*)

Philephedra scale

False oleander scale

edra scale

Major diseases of mango in Florida

- Anthracnose (*Colletotrichum gloeosporioides*) – periodic fungicide applications from bloom to harvest.
- Powdery mildew (*Oidium* sp.) – 1-2 fungicide applications during bloom.
- Mango scab (*Elsinoe mangiferae*) – periodic fungicide sprays during fruit set and early fruit development.

Powdery mildew

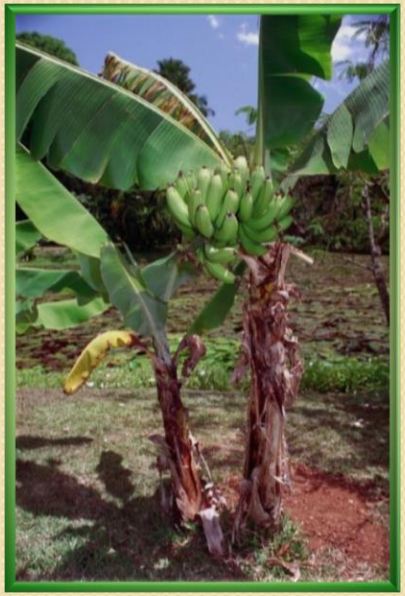
Fungicides:

- Copper, sulfur, strobilurin, Bacillus, Streptomyces, propiconazole, maneb, tebuconazole, oils, chlorothalonil, fludioxonil, cyprodinil

BANANA

Scientific Name:
Musa acuminata

Tropical:
- Herb,
- Fast growing,
- Height From 2’-30’,



Banana Plant nutrition and fertilization

- Leaf litter and/or mulching is beneficial.
  - Apply 4-6 inch layer of mulch from the base of the stems outward 3 to 5 ft.
- Bananas should be fertilized frequently for maximum production.
  - The potash requirement is high
  - Use fertilizers with a high K_2O content
    - N-P_2O_5 -K_2O in a ratio of 3-1-6.
    - Amount of fertilizer depends on size and age of the stalk and on the number of stalks per clump.

During winter months if warm (>60°F) then fertilize and water

Banana Plant nutrition and fertilization

- Young plants should be started with 1/2 lb of a 6-2-12 or similar formula
  - Also apply 2-3% magnesium every 2 months
  - Gradually increase to 3.0 lb to 4.0 lb at flowering and fruiting time, 10 to 18 months later.
- Secondary (Mg) and minor (Mn, Zn, Fe, etc.) elements should be applied on a maintenance level to maintain tree health

Months from planting	Number of application	Amount/mat/ application (lbs)
1-6	**3**	**0.5-1.0**
6-12	**3**	**1.0-2.0**
12-18	**3**	**2.0-3.0**
18+	**3**	**3.0-4.0**

Nitrogen and Iron deficiency

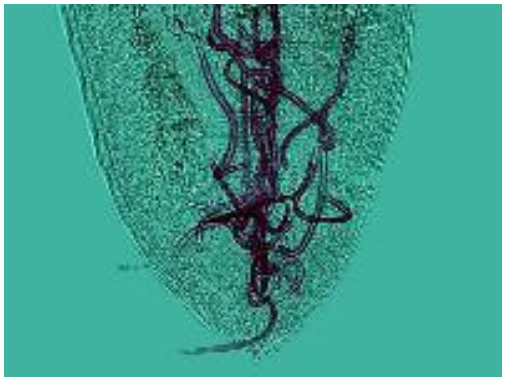
-intervienal chlorosis and plant stunting-

Major banana diseases and pests in Florida

- **Panama disease**
  - **Fusarium wilt**; ***F. oxysporum* f. sp. *cubense***
- **Yellow Sigatoka**
  - ***Mycosphaerella musicola***
- **Black Sigatoka**
  - ***M. fijiensis***
- **Banana weevil**
- **Sugar-cane weevil**

***Unlike beetles, weevils have a snout.**

- Nematodes
  - **Burrowing nematode**
    - ***Radopholus similis***
  - **Spiral nematode**
    - ***Helicotylenchus multicinctus***
  - **Lesion nematodes**
    - ***Pratylenchus coffeae***



FOR YELLOW SIGATOKA

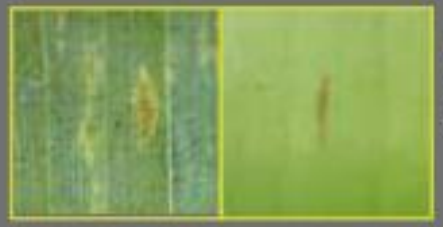
• **Stage 1:** A tiny yellow spot or light green streak on the upper surface of leaves.

> Hardly observable.

YELLOW SIGATOKA Upper surface | BLACK SIGATOKA Lower surface

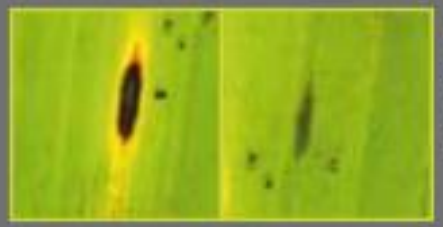
• **Stage 2:** The spots stretch out into yellow streaks of 3-4mm; this is the optimal stage for treatment.

> Streaks 1 to 5 mm.



• **Stage 3:** The streaks widen into large spots; the center developing a rusty colouration.

> Large spots.
CONTAMINATION +



• **Stage 4:** the lesion reaches its definite size (12-15 mm on 2-5 mm) with a yellow halo; the centre is dark brown to black.

CONTAMINATION ++

• **Stage 5:** The central zone of the lesion dries up and turns gray with a black ring and a yellow halo. It is referred to as the 'necrosis' stage. At this stage, the ascospores appear and are then dispersed by the wind.

> Necrosis.
CONTAMINATION + + +

• **Stage 6:** No stage 6.

Yellow Sigatoka

Black Sigatoka - black leaf streak

Panama disease = Fusarium Wilt

Fungicides for Banana Diseases :

- Copper,
- sulfur,
- strobilurin,
- Bacillus,
- Streptomyces,
- propiconazole,
- maneb,
- tebuconazole,
- oils

Guava

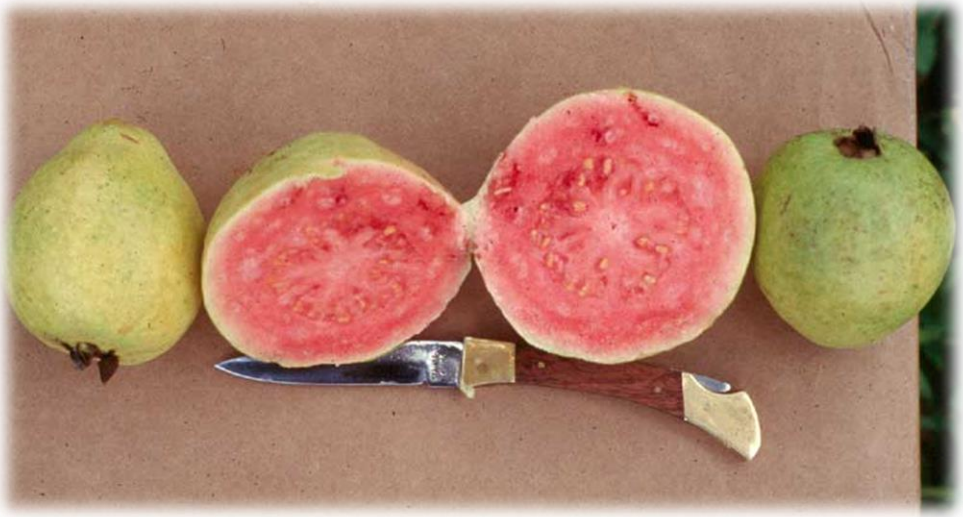
Scientific Name:
Psidium guajava

Myrtaceae:

- Wax jambu
- Jaboticaba
- Surinam cherry
- Clove
- Allspice
- Eucalyptus

Tropical/Sub-Tropical:

- Shrub or small tree
- Up to 25 feet



Young trees begin to produce commercially scale after 2 (white) to 3 (pink) years.

Guava crop production in Florida

Pink guava

- Young trees begin to produce on a commercial scale after 2 to 3 years.
- Yields from mature trees ranges from 50-80 lbs per tree however, greater yields are possible.
- 10,000 lbs to 30,000 lbs/acre

White guava

- Young trees begin production on a commercial scale after2 years.
- Yields from mature trees ranges from 35-100 lbs per tree, however greater yields are possible.
- 13,000 lbs to 44,000 lbs/acre

General guava practices

Operation	J	F	M	A	M	J	J	A	S	O	N	D
Fertilizer NPK		NPK 2-4 times; K 2 times										
Micronutrients			**Mg, Mn, Zn, Fe, B, Mo, etc.**									
Irrigation			During dry periods (1-2 times/wk)									
Insect control	Fruit fly control year-round when fruit present; others as needed											
Disease control			During rainy season									
Pruning												
Harvest												
Frost protection												

Mite damage

Caribbean fruit fly

Bagging for Caribbean fruit fly control

Major guava diseases

- Red alga (*Cephaleuros virescens*) – periodic copper applications especially during the wet season.

- Anthracnose (*Colletotrichum gloeosporioides*) – cultivar dependent; on susceptible cultivars/selections apply fungicides at fruit set to harvest.

Anthracnose

Florida: guava stem dieback

-*Neofusicoccum* sp.-

Prune out
dead wood
and destroy

Annonaceae

- 46 genera and 500-600 species
- Important fruit crops:
  - **Cherimoya**
  - **Atemoya**
  - **Custard apple**
  - **Sugar apple**
  - **guanabana (soursop)**
- Origin varies:
  - South and Central America, Mexico.

Cherimoya

Atemoya

Custard apple

Sugar apple

Botany and evolution of *Annona*

Common name	Scientific name	Origin
Cherimoya	*Annona cherimola*	Andes of South America (Ecuador, Peru, Bolivia)
Atemoya	*A. cherimola x A. squamosa*	Naturalized hybrids where species overlap; manmade crosses
Sugar apple	*Annona squamosa*	Tropical America

Historically has not done well in FL.

Adaptation of *Annona* species

Common name	Climatic adaptation
Cherimoya	Cool subtropical, mild-temperate, and highland tropics
Sugar apple	Lowland tropical and warm subtropical areas
Atemoya	Lowland tropical, warm and cool subtropical areas

Common name	Flowering	Harvest	# of days
Cherimoya	Jan-June	May-Dec	~150
Atemoya	April-July	Aug-Oct	150-180
Sugar apple	May-July	July-Sept	120-150

Botany of sugar apple (*Annona squamosa*)

- Small, trees to 15-20 ft tall
- Shallow root system
- Semi-deciduous – cool temperatures, drought, rainfall, and disease pressure
- Flowers are small, singly or in clusters
- Aggregate fruit type

Climatic adaptations – sugar apple optimum

- Generally adapted to areas with
  - Summer, 68-95°F
  - Winter, 40-75°F
    - mature trees may withstand short periods of 30°F
- Shoot growth, >75/62°F to 90/81°F (day/night)
- Root growth, >70°F
- Flowers arise from current season and to a lesser extent from 1-year-old wood
- Temperatures <~72°F and >90/81°F (day/night) may reduce flower production
- Fruit set ranges from 72-84°F and 70-99% RH
- Fruit growth ranges from 72°F to 86°F

Site selection

Soils

- Well drained and aerated
- Fertile
- Moderate % organic matter content
- pH 6.0-7.0 best
  - Tolerates up to pH 8.4

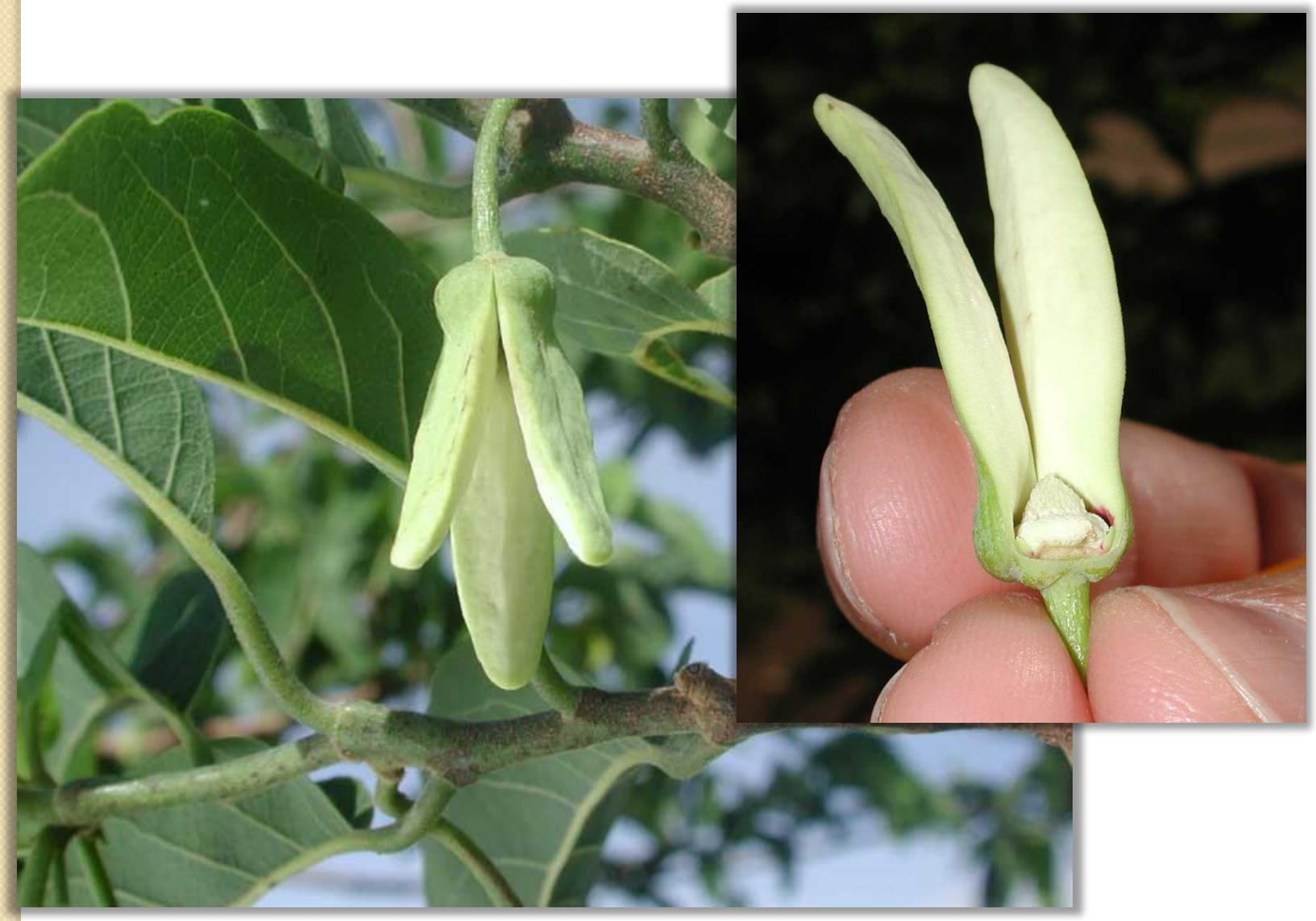
Wind

- Protection from strong and/or constant winds.

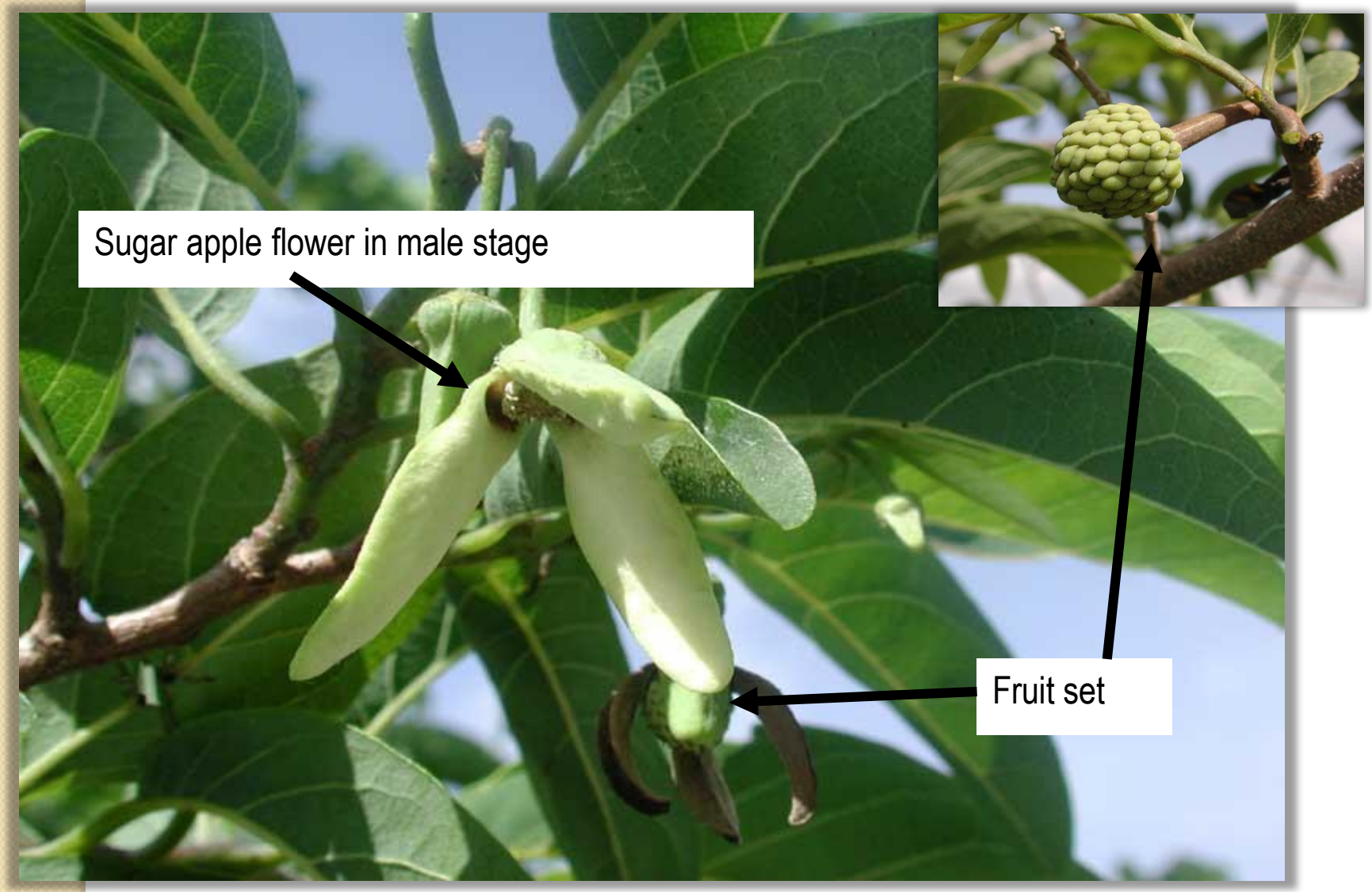
- Drought tolerance is moderate but results in leaf drop and reduced production and fruit size.
- Solution: irrigation system and proper management
- Flood tolerance is generally poor, influenced by rootstock.
- Salinity tolerance is low.

Flower biology

- Have hermaphroditic (bi-sexual) flowers.
- Female flower parts are receptive prior to pollen shedding.
- Flowers function as females first, then male.
- Flowers in the female stage are characterized by slight opening of the petals and a glistening appearance to the stigmatic surfaces.
- Male stage flowers have petals wide open and may easily fall when touched and stamens develop a brownish color.
- Duration of flowering of individual flowers is ~33 hours.



Sugar apple flower in female stage

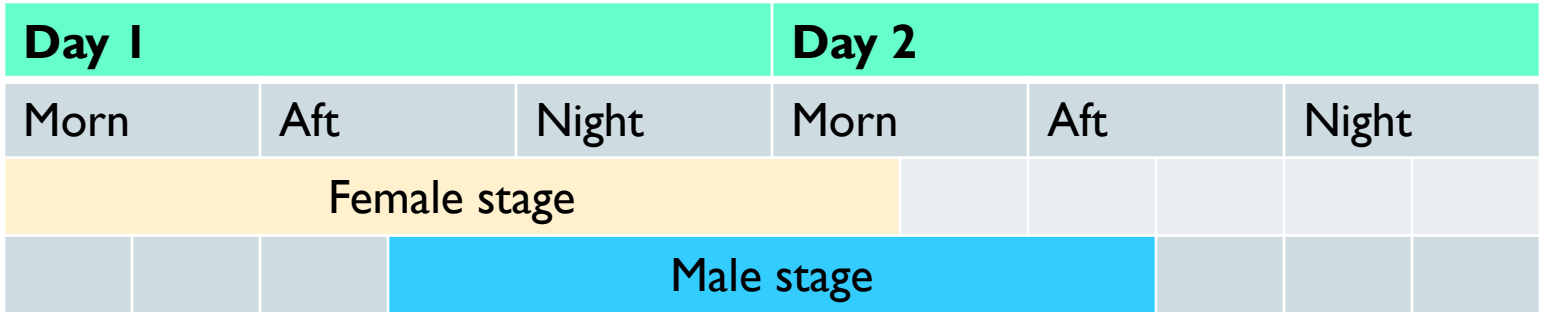

Sugar apple flower in male stage
Fruit set

Flowers in the female and male stages

Stigmatic surfaces viable

Pollen release

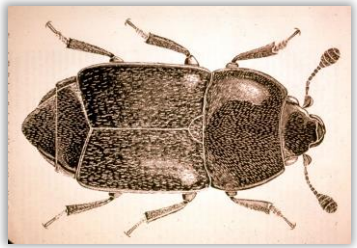
Sugar apple flowering sex cycle



- Flowers in female stage first, then male stage.
- Females most viable during early morning to mid-day.
- High relative humidity (>80%) weather conditions favors pollination and percent fruit set.
- Fruit set due to natural pollination ranges from 0 -10% for sugar apple.
- Self incompatibility may limit fruit set.
- Cross pollination among cultivars and/or species increases percent fruit set.

Natural pollination biology

- The natural pollinators of *Annonas* are Nitidulid beetles sometimes called sap beetles.
- Three main species are involved, *Carpophilus mutilatus, C. fumatus, and Haptoncus luteolus*.
- Beetles are attracted to the flowers by the odor emitted by female flowers.



- Beetles feed on the stigmatic surfaces and pollen – effecting pollination.
- As the number of beetles visiting a flower increases (1-6+ times) the percent fruit set increases.
- Beetle pollination not usually effective.
  - Low populations

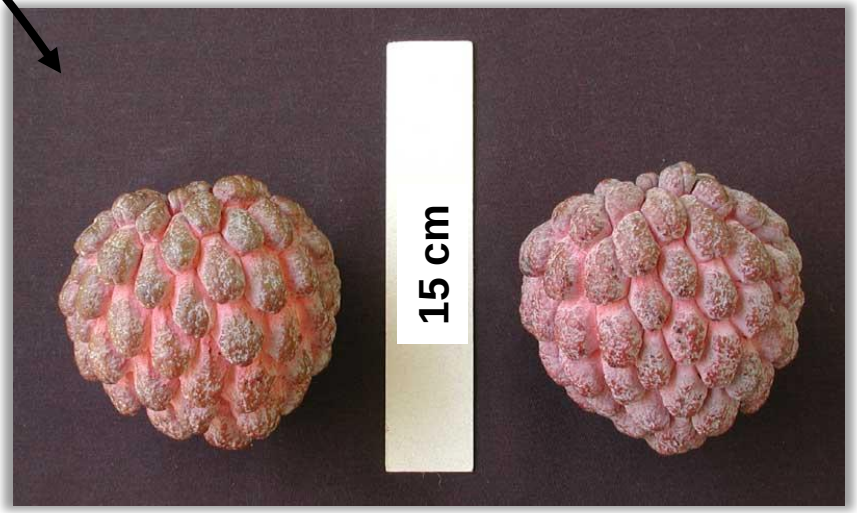
Hand pollination

Steps to hand pollination

- Tools: medium size water color paint brush, small plastic container to hold pollen and/or male stage flowers.
- **Option A**: Pollen is collected from stamens of flowers in the male stage (late afternoon, evening, or early morning). The stamens are placed on paper and allowed to dehisce and the pollen stored overnight.
  - Pollen may then be mixed with lycopodium dust or talcum powder to improve handling and transfer to flowers in the female phase.
- **Option B**: Collect already open male flowers in the early morning and remove petals, touch brush to anthers frequently during hand pollination operation.
- Hand pollination is usually most effective early to mid-morning and may be affected by using a thin brush to transfer the pollen to the slightly open flower petals to the stigmatic surfaces at the base of the female flower.

Sugar apple cultivars

- ‘Lessard Thai’ (green)
- ‘Kampong Mauve’ (red)
- ‘Purple’
- ‘Red’
- Cuban seedless
- Brazilian seedless



Fertilizer management

Year/age	Appl./yr	Amt./tree/appl. (lb)	Comments
1	5-6	0.25-0.5	NPK
2	4-5	0.5-0.75	NPK
3	4-5	0.75-1.0	NPK
4	2-4	1.0-2.0	Use NPK and K alone.
5	2-4	1.5-2.5	
6	2-4	2.5-3.0	
7	2-4	3.0-3.5	
Foliarly apply micronutrient elements except Fe apply to ground.			

General sugar apple practices

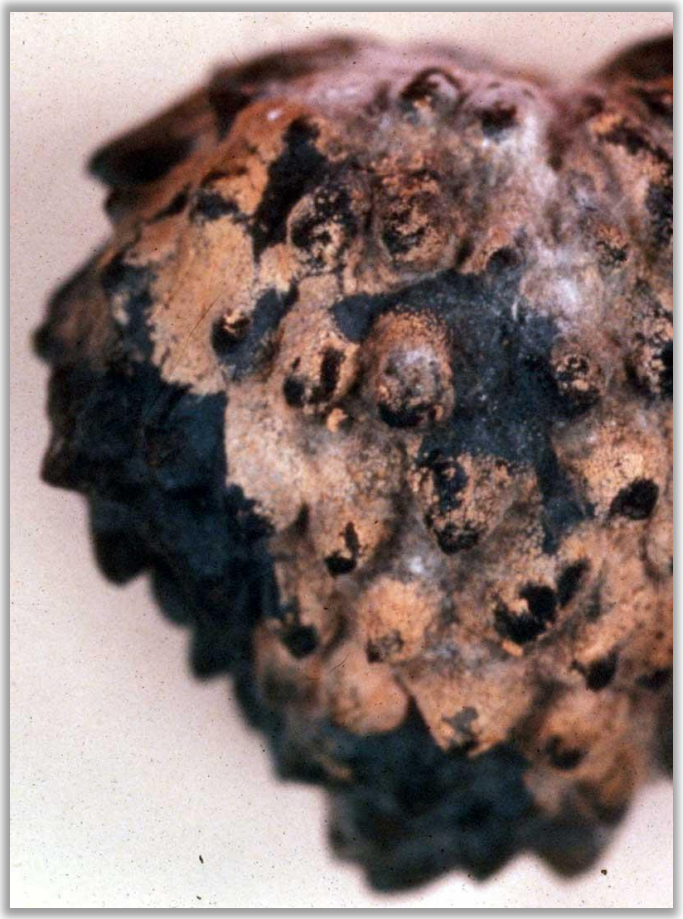
Operation	J	F	M	A	M	J	J	A	S	O	N	D
Pruning												
Pollination												
Fertilizer NPK			NPK		NPK		K		K			
Micronutrients			Mg, Mn, Zn, Fe, B, Mo, etc.									
Insect control												
Disease control												
Irrigation												
Frost protection												
Harvest												

Major diseases and insects in Florida

- Anthracnose (*Colletotrichum gloeosporoides*)
- Diplodia fruit rot (*Botryodiploidia* sp.)
- Purple blotch (*Phytophthora* sp.)
- Rust (*Phakospora* sp.)
- Annona seed borer (*Braephratiloides cubense*)
- Plumose scale (*Morganella longispina*)
- Philephedra scale (*P. tuberculosa*)
- Mealy bugs

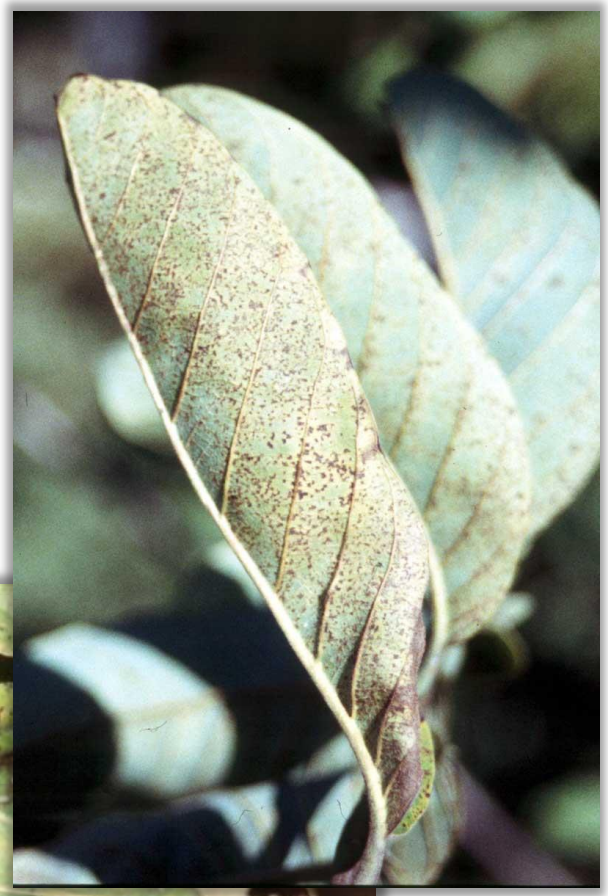
Fruit rot

Fruit rot
anthracnose



Rust (*Phakospora* sp.)

- Rust fungi attack leaves during the cool weather; reduced fruit quality, and yields.



Annona seed borer (ASB)

- A limiting factor in fruit production in some areas.
- ASB adults oviposit in seeds of young fruit (<6 cm dia.) and larvae feed on seeds, pupates, and emerge as adults by boring to the surface of the fruit. There are several generations of ASB per year.
- Control strategies
  - Monitor for presence of ASB and spray insecticides
  - Isolate the planting from nearby *Annona* plantings
  - Bag the fruit

Management

- Pests
  - Insects
  - Pathogens
  - Weeds
  - Animals
  - Humans

- Start with a weed-free bed and seed.
- Have good soil drainage.
- Plant at proper depth and spacing.
- Water/fertilize/mulch correct amounts & place.
- Mind the weather and all label instructions.
- Scout for animals/insects/disease early & often.
- Develop IPM Strategy & implement as needed.
  - Integrated Pest Management

The 6 IPM Principles

1. **Prevention**

2. **Scouting**
   - Monitor & assess pest numbers & damage.

3. **Management Guidelines**
   - When is action needed?

ASK a master gardener

4. **Numerous tools** used to mitigate pest issue.
   - *Suppression NOT eradication*

5. **Evaluation** of tools' efficacy.

6. **Record keeping**.

Limiting Pesticide Use

What can be done?

- Scout early & often
- Remove by hand when possible
- Proper ID & pesticide choice
- Spot-treat problems
- Utilize beneficials
  - Properly ID
  - Use softer pesticides
  - Use selective pesticides
  - Keep or plant refugia
  - Have a no-spray zone
  - Purchase & release

What else can be done?

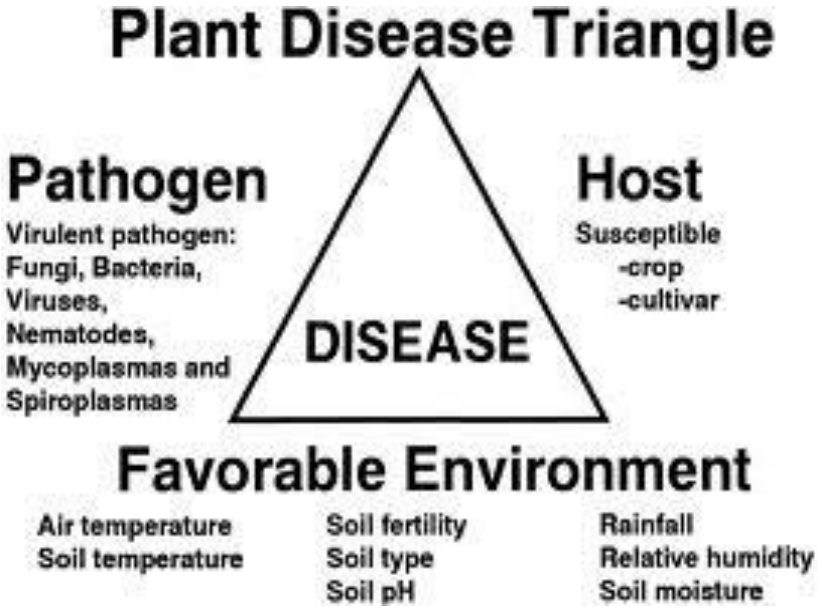
- Start with clean seed
- Start with health plants
- Good cultural practices
  - Right plant, place, time
  - Irrigation & nutritional BMPs
- Good sanitation habits
  - Clean hand-tools after use
  - Work young to old plants & clean to dirty areas
  - Use mature compost
  - Remove diseased plants
  - Kill weeds before they seed

Insect Management

- Insecticidal Soap
- Horticultural oil
- Biological Control
- Physical Removal
- Breaking Lifecycle

IPM – Integrated Pest Management

- **Pests include:**
  - **Insects**
  - **Pathogens**
    - **Fungi**
    - **Bacteria**
    - **Viruses**
  - **Animals**
    - **Nematodes**
    - **Vertebrates**
  - **Other plants**
  - **Proper ID is essential!!**



General Pest Management

- **Disease**
  - **Prevent: sanitation, solarization, rotation, R varieties**
  - **Cultural: rouge, manage water, fertilizer & air.**
- **Prevent Weeds via killing before seeding**
  - **Weed seed from poor compost/grazing manure.**
- **Nematodes:**
  - **Prevent, rotate, destroy roots, flood, fallow.**
- **Insects**
  - **Remove by hand.**
  - **Protect & encourage beneficials with refugia.**
  - **Pesticides as last resort**
    - **FOLLOW LABEL INSRUCTIONS**
    - **LABEL = LAW**

Disease Management

Copper:
- Anthracnose
- Greasy Spot
- Sooty Mold
- Scab

Sulfur:
- **Powdery Mildew**

What did we cover?

- Florida Tropical Fruit
- Major Pests Diseases
  - **Citrus**
  - **Avocado**
  - **Papaya**
  - **Pineapple**
  - **Mango**
  - **Banana**
  - **Guava**
  - **Sugar Apple**

Acknowledgments

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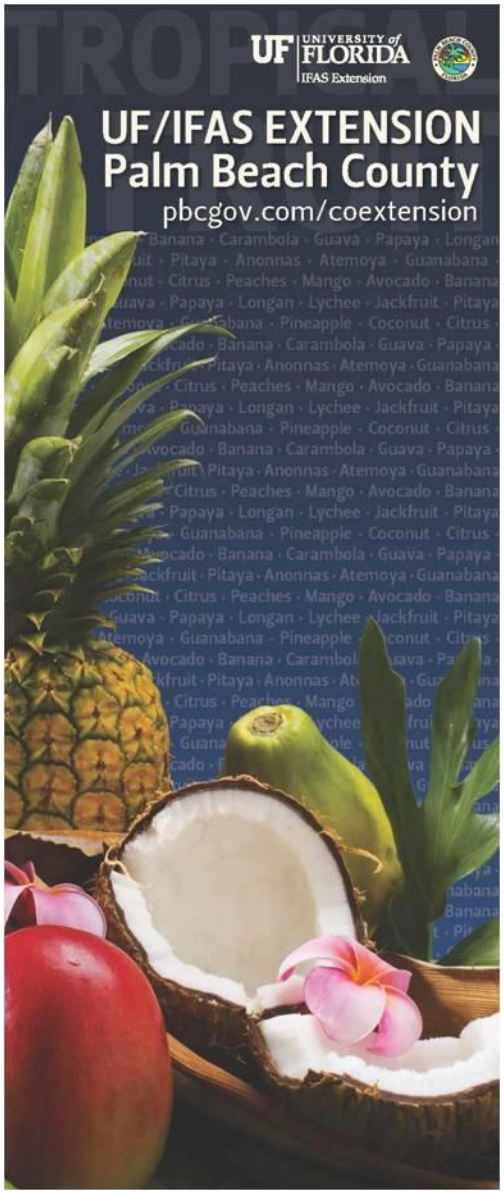
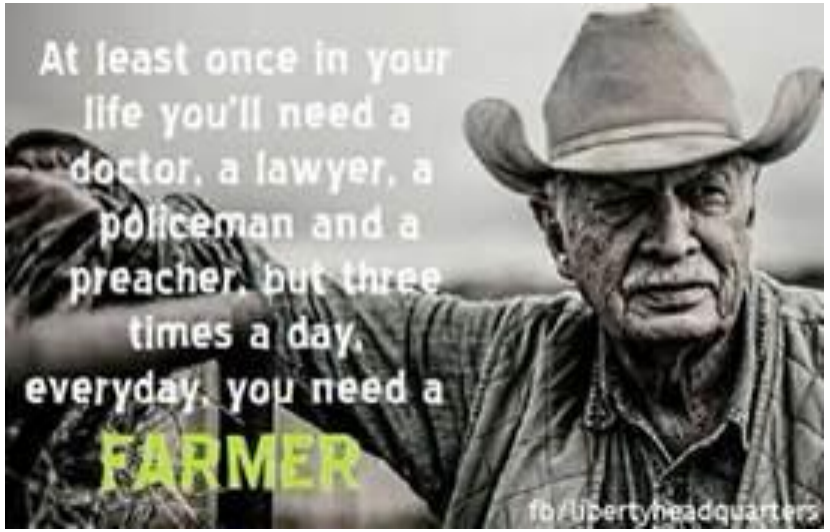
- IPM Florida (http://ipm.ifas.ufl.edu/)
- UF/IFAS Palm Beach County Extension
  - http://discover.pbcgov.org/coextension/Pages/default.aspx
- Dr. Jonathan Crane (UF/IFAS TREC)
- University of Georgia Extension (https://extension.uga.edu/)
- https://www.ipmimages.org/
- https://www.slideshare.net/
- http://edis.ifas.ufl.edu/
- https://www.bugwood.org/



Any questions?



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