DOORYARD CITRUS WOES

Day of Gardening
February 26, 2017
Larry Figart Duval County Extension Service
lfigart@coj.net

MOST CITRUS TREES ARE GRAFTED

ADVANTAGES OF GRAFTING OR BUDDING
- Reduces juvenility period
- Fewer thorns
- Reduces tree vigor
  - Seedling trees grow more upright
- Produces a tree that is true-to-type
- Ability to adapt tree to soil conditions via use of a rootstock
- Disease and/or virus tolerance
  
  See Chart in the back of the handout

COLD HARDINESS IS INFLUENCED BY:
- Rootstock
- Scion
- Temperatures prior to a freeze

ROOTSTOCK
- **Least cold tolerant**
  - rough lemon, Rangpur lime, Volkamer lemon, Milam, Palestine sweet lime,
- **Intermediate**
  - sweet orange, Carrizo citrange
- **Most cold tolerant**
  - sour orange, Cleopatra mandarin, trifoliate orange (flying dragon), Swingle citrumelo

SCION
- Early Season Cultivars are the best choice because fruit is produced earlier.
- Hamlin, Parson Brown, Ambersweet and Navels are considered Early Season Cultivars
- As a general rule mandarins are the most cold tolerant, then sweet oranges and grapefruit.
- Lemons and limes generally are the least cold tolerant.
TEMPERATURES BEFORE THE FREEZE

- Citrus trees can become more “cold tolerant” if they are exposed to colder temperatures for about two weeks prior to the freeze.
- 70 degree days and 50 degree days for trifoliate orange
- Rough lemon rootstock does not become cold tolerant until temperatures reach 45/26 two weeks prior to the freeze.
- Unseasonably warm winter temperatures can cancel out this environmental conditioning.

POLLINATION

- Many cultivars are self fertile
- Some require pollinators

COLD PROTECTION

- Mounding
- Covering
- Lamps
- Ice formation (not recommended)

POLLENIZER CULTIVARS FOR SELF-INCOMPATIBLE CITRUS CULTIVARS

<table>
<thead>
<tr>
<th>Hybrid to be Pollenized</th>
<th>Minneola</th>
<th>Nova</th>
<th>Temple</th>
<th>Murcott</th>
<th>Temple Murcott</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minneola</td>
<td>S</td>
<td>U</td>
<td>U</td>
<td>U</td>
<td>U</td>
</tr>
<tr>
<td>Nova</td>
<td>S</td>
<td>U</td>
<td>S</td>
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<tr>
<td>Temple</td>
<td>S</td>
<td>U</td>
<td>S</td>
<td>U</td>
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</tr>
<tr>
<td>Minneola Nova</td>
<td>S</td>
<td>U</td>
<td>U</td>
<td>U</td>
<td>U</td>
</tr>
<tr>
<td>Temple Nova</td>
<td>S</td>
<td>U</td>
<td>U</td>
<td>U</td>
<td>U</td>
</tr>
<tr>
<td>Minneola Temple</td>
<td>S</td>
<td>U</td>
<td>U</td>
<td>U</td>
<td>U</td>
</tr>
<tr>
<td>Minneola Murcott</td>
<td>U</td>
<td>U</td>
<td>U</td>
<td>U</td>
<td>U</td>
</tr>
<tr>
<td>Nova Temple</td>
<td>U</td>
<td>U</td>
<td>U</td>
<td>U</td>
<td>U</td>
</tr>
<tr>
<td>Temple Murcott</td>
<td>U</td>
<td>U</td>
<td>U</td>
<td>U</td>
<td>U</td>
</tr>
</tbody>
</table>

S=Satisfactory, U=Unsatisfactory, ?: Unknown

FREEZE INJURY

Fruit damaged if temperatures drop below 28°F for 4 for more hours
PLANTING IN CONTAINERS

- Calamondin
- Key Lime
- Kumquat
- Limequat
- Tahiti Lime

CITRUS VARIETIES

- Oranges
  - Navel
  - Red Navel
  - Hamlin
  - Pineapple
  - Valencia
- Grapefruit
  - Duncan
  - Marsh
  - Mixed red varieties
- Tangerines & Hybrids
  - Satsuma
  - Faligio
  - Sunburst
  - Dancy
  - Temple
  - Orlando
  - Minneola
  - Murcott
  - Robinson

SUGGESTED FERTILIZATION SCHEDULE

<table>
<thead>
<tr>
<th>Tree Age</th>
<th>Lbs N/tree/yr</th>
<th>Lbs Fertilizer/tree/yr</th>
<th>Applications/yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.15-0.30</td>
<td>2.5-5.0</td>
<td>1.8-3.8</td>
</tr>
<tr>
<td>2</td>
<td>0.30-0.60</td>
<td>5.0-10.0</td>
<td>3.8-7.5</td>
</tr>
<tr>
<td>3</td>
<td>0.45-0.90</td>
<td>8.0-15.0</td>
<td>5.6-11.3</td>
</tr>
<tr>
<td>4</td>
<td>0.80-1.0</td>
<td>13.0-17.0</td>
<td>10.0-12.5</td>
</tr>
<tr>
<td>5+</td>
<td>1.1-1.4</td>
<td>18.0-23.0</td>
<td>13.8-17.5</td>
</tr>
</tbody>
</table>

Tree age = years planted, with year 1 beginning right after planting.
Do not use a fertilizer with higher than an 8-8-8 analysis on young trees during years 1-3.

WHEN TO FERTILIZE

- Young trees
  - Apply at 6-week intervals
  - Fertilizer should be applied beginning in:
    - Late Feb-early March
    - Ending in late September

- Mature trees
  - Apply 3 applications per year
    - Late February-early March
    - mid May
    - Mid-late September
  - Avoid applications during summer rainy months due to potential leaching
**HOW TO APPLY THE FERTILIZER**

- **Young trees**
  - Apply fertilizer uniformly in a 3 foot diameter circle around the tree

- **Mature trees**
  - As the tree becomes older, increase area covered with fertilizer
  - Fertilize an area twice the diameter of the tree canopy
  - Do not apply against the tree trunk

**CITRUS DISEASES**

- The most common fungal diseases are:
  - Greasy spot
  - Melanose
  - Scab
  - Foot rot.

- The first three affect fruit, leaves, and twigs
- Foot rot directly affects the trunk of the tree

**SOIL PH**

- Adjust soil pH up to approximately 6.0-6.5
  - Materials for pH adjustment include
    - Dolomite
    - High calcium lime

- For high pH soils, > 7.0-7.5
  - Very difficult to reduce soil pH
  - Many micro nutrients may need to be applied to the foliage of the tree

**PESTS AND DISEASES**

**GREASY SPOT**

- Leaf tissue collapses after infection of fungus
- Leaves function for 2 to 3 years before drop
- Heavily infections cause premature, severe leaf drop
- Can result in loss of tree vigor
- External fruit will have pinpoint black specks on the rind
- Occurs on grapefruit, lemons, and tangelos
  - (Sweet oranges and mandarins are less susceptible.)

- Management
  - Remove and destroy fallen citrus leaves
  - Don't use infected leaves as mulch
  - Don't bury them. Destroy before summer rains
  - Use oil and copper sprays for control
Greasy Spot Management

Recommended Chemical Control for Greasy Spot

<table>
<thead>
<tr>
<th>Pesticide</th>
<th>Rate/Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petroleum Oil 97+% FC 435-66, FC 455-88 or FC 470</td>
<td>Use label rates. Do not apply when temperatures exceed 94°F.</td>
</tr>
<tr>
<td>Copper fungicide</td>
<td>Use label rate.</td>
</tr>
<tr>
<td>Copper fungicide + Petroleum Oil 97+% FC 435-66, FC 455-88 or FC 470</td>
<td>Use label rate of each. Do not apply when temperatures exceed 94°F.</td>
</tr>
</tbody>
</table>

Management:
- The best scab management strategy is to remove and destroy the source (infected leaves, twigs, and fruit) of inoculum, controlling the disease before it develops momentum.
- Avoid overhead irrigation that spreads scab.
- Copper sprays also can be applied 2-3 weeks after petal fall, and again 2-3 weeks later to control scab.

Citrus Scab

- Small, somewhat circular, elevated spots on leaves and fruit
- Infection becomes wart-like structures, covered with a corky pale tissue
- Pustules may group together
- Can be severe on Temples, lemons, Murcotts, Minneola, grapefruit

MELANOSE

- Small, dark brown, raised lesions on leaves that have a rough, sandpaper texture
- Fungal spores stream down the surface of fruit forming a "tear-streaking"
- Smaller lesions coalesce to form a large one, a "mudcake" lesion develops

SCAB

- Management:
  - The best scab management strategy is to remove and destroy the source (infected leaves, twigs, and fruit) of inoculum, controlling the disease before it develops momentum.
  - Avoid overhead irrigation that spreads scab.
  - Copper sprays also can be applied 2-3 weeks after petal fall, and again 2-3 weeks later to control scab.

Fruit susceptible

Delayed dormant application. This treatment is required only on groves with a history of severe scab problem.
- Two-thirds petal fall application. This is the only treatment necessary with light infestation. This treatment is also needed in conjunction with delayed dormant spray on groves with severe scab problem.
- Melanose spray. Treatment at this time for melanose also reduces scab infection.

Recommended timing of fungicide applications to control sour orange scab on Florida citrus.
Both rust mite blemishes and melanose fruit lesions are brown but melanose lesions have a rougher texture. Melanose lesions cover oil glands on the fruit surface but greasy spot lesions do not. Inoculum is produced only on recently killed twigs. Melanose is usually more severe in older, neglected trees and cold-damaged trees with large amounts of dead wood and twigs.

All cultivars are affected:
- Does not cause leaf drop but leaves are susceptible until fully expanded
- Fruit damage is only superficial but is susceptible for 12 weeks after petal fall

Management:
- Best choice is:
  - Remove small, dead twigs
  - Avoid overhead irrigation.
- If you use copper sprays follow directions on label

Recommended Chemical Control for Melanose

<table>
<thead>
<tr>
<th>Pesticide</th>
<th>Rate/Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper fungicide</td>
<td>Use label rate</td>
</tr>
</tbody>
</table>

Mid April-Mid May

Lesions on tree trunk usually on the bark at or just above the bud union on susceptible scions.

Lesions first appear as a drop of gum on the surface of the bark.

Brown, discolored, necrotic, slippery areas will be found under the bark.

Lesions can eventually girdle the entire tree trunk.

Can occur when bark is damaged with tools as this allows easy entry of the disease into the tree.

Planting at proper height in soil minimizes problem.

Foot Rot (Phytophthora nicotianae)
**Foot Rot and Root Rot Management**

**Recommended Chemical Control for Foot Rot and Root Rot**

<table>
<thead>
<tr>
<th>Pesticide</th>
<th>Rate/Acre</th>
<th>Method of Application</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper-Wettable Powder</td>
<td>0.5 lb (metallic)</td>
<td>Trunk paint</td>
<td>Protectant</td>
</tr>
<tr>
<td>Copper-Count-N</td>
<td>1 qt in 3 qt water</td>
<td>Trunk paint</td>
<td>Protectant. Do not apply to green bark; may cause gumming.</td>
</tr>
</tbody>
</table>

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**ALTERNARIA BROWN SPOT**

- Causes fruit drop
- Affects Dancy tangerines and Minneola tangelos
- Produces leaf spots, leaf drop, fruit spots and fruit drop.
- Avoid overhead irrigation especially during bloom development but normal rain fall, dew, or fog can also wet blossoms
- Copper sprays

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**Brown Rot (Phytophthora species) on fruit**

**Citrus Canker (Xanthomonas axonopodis)**

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**BROWN ROT OF FRUIT**

- Infected fruit exhibit a light brown, leathery decay.
- Has a characteristic pungent, rancid odor.
- Fruit may become infected via soil contact, splash dispersal with soil particles or fruit-to-fruit spread by windblown rain.
- Infected fruit fall from tree.
- Greater problem in late summer (Aug-Sept) if conditions are wet.
- Early varieties more susceptible than late maturing varieties.

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**CANKER**

- Citrus canker, caused by a bacterial pathogen Xanthomonas axonopodis pv. citri, is a serious disease of most citrus varieties. The disease causes necrotic lesions on leaves, stems, and fruit.
CITRUS CANKER
- Lesions are produced on young fruit and leaves of citrus.
- Bacteria are produced under moist conditions and dispersed by windblown rains.
- Bacteria enters leaf stomates or wounds on leaves, twigs or fruit.
- No chemical control.

CITRUS GREENING
- HLB first was detected in the U.S. near Miami, Florida in August 2005, and to date has been confirmed to have spread to 38 Florida counties and most recently to Louisiana and California.

HLB
- The causal agent of Huanglongbing (Citrus Greening)
- HLB is a phloem-limited bacterium
- The affected fruit often contain aborted seeds and have poor juice quality

ASIAN CITRUS PSYLLID
- Psyllids fly or are carried by the wind to new plants
- Psyllids feed on an infected tree and then transmit the bacteria to healthy trees

CITRUS GREENING
- Caused by the bacterium: Candidatus Liberibacter asiaticus
- Affects all citrus varieties
- No cure for the disease
- Spread from tree to tree by the Asian Citrus Psyllid

VERY SMALL INSECTS
- Citrus Greening bacterium in citrus tissue
Can infect nearly all citrus species, cultivars and hybrids, as well as some citrus relatives. The HLB bacterium can also multiply in Chinese box orange (Severinia buxifolia) and wood apple (Limonia acidissima).

**Fruit Symptoms**
- Fruit external appearance may be lopsided, misshapen or small green fruit
- The fruit would taste salty and bitter
- The internal appearance may have aborted seeds, yellow stain beneath the calyx button and/or a curved central core

**Leaf Symptoms**
- Leaf symptoms include blotchy mottle, yellow veins, vein corking or green islands
- Yellow veins, vein corking or green islands are not diagnostic alone

**Tree Appearance**
- Yellow shoots
- Twig dieback
- Stunting
- Off-season bloom
- Overall tree decline

Figure 1. Yellow shoot symptom (indicated by arrowhead) on sweet orange tree affected by greening.
DIAGNOSING LEAVES

- Circle areas on opposite sides of the mid-vein. Are they the same on both sides?
- Nutrient deficiencies are symmetrical and HLB symptoms are asymmetrical

WHERE TO SEND SAMPLES

Mail samples to:
UF Plant Diagnostic Center
2570 Hull Rd, Bldg 1291
Gainesville, FL 32611-0830

http://plantpath.ifas.ufl.edu/clinic/

LOOK A LIKES

IODINE TEST

1. Using a sharp, clean razor blade, cut a section from the selected leaf that includes the symptomatic tissue. Do not cut through the mid-vein, rather cut sections from the leaf blade on either side of the mid-vein.
2. Immerse the cut section(s) of leaf in the prepared iodine solution for 1.5 - 2 minutes.
3. Remove the sections and rinse with clear water.
4. Examine the cut edge of the section(s) for dark staining using a hand lens or magnifying glass.

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FUTURE GREENING CONTROL

- At the present time there is NO Control for HLB
- Some research is being applied to develop an environmentally safe, systemic bactericide that can be applied with conventional spray or drench technology.
- Create ways to provide steam-generated treatments as an immediate, short-term solution to sustain productivity in HLB-affected trees
- Citrus breeding program to develop an HLB-resistant citrus cultivar.
- Develop an effective microbial treatment for citrus plants affected by HLB.
- New methods to control the Asian Citrus Psyllid
- Genetic Modification

IDENTIFICATION OF INSECT PESTS
**Eastern Lubber Grasshopper, *Romalea microptera* (Beauv.):**
- Adult above, nymphal stage below
- Native grasshopper.
- Adult is brilliant yellow with red and black markings, approximately 2 inches long.
- Nymphs are solid black.
- Female lays eggs in soil in generally wet areas or in woodland areas.
- Can defoliate young citrus trees.

**Southern Green Stinkbug**
- Bright green with broadly oval shield-shaped body.
- Approximately 1 inch long.
- Damage to fruit is by piercing-sucking mouthparts.
- When peel is damaged, a discolored and dry area often appears in the flesh below the damaged area.

**Orangedog, *Papilio cresphontes* (Cramer) Swallowtail Butterfly**
- Larval stage feed on young foliage causing extensive damage and defoliation.
- Larval stage is brown and white caterpillar which resembles bird droppings.
- Approximately 1-2 inches in length.
- Adult stage is the swallowtail butterfly.

**Citrus Leafminer, *Phyllocnistis citrella* (Stainton)**
CITRUS LEAFMINER

- Adults are minute moths, with ¼ inch wingspread.
- Females lays eggs in evening or early morning on young foliage.
- Larvae are translucent greenish.
- Upon larva entering the leaf, they begin to feed producing a serpentine larval mine.
- Damage results in leaf distortion, leaf drop and possible stem dieback.

KATYID

- Adult is 2-2.5 inches long with slender legs.
- Feed on foliage and may causing sunken area on fruit.
- Eggs are brown to grey in color and laid in a row along leaf margin or slightly inserted in edge of leaf.
LEAF-FOOTED BUG

- Dark brown with a yellow band across the body.
- Puncture the fruit rind allowing decay organism to enter.
- Feeding damage results in premature color break and fruit drop.

Citrus Rust Mite Damage to Fruit

Bronzing (summer or fall injury)

Sharkskin (spring injury)

SOOTY MOLD

- Dense, black fungus that grows on the honeydew secreted by insects like aphids, scales, whiteflies and mealybugs.
- Found on leaves, stem, and fruit.

Sooty Mold

CITRUS RUST MITES

- Damages epidermal cells of leaves and fruit using piercing-sucking mouthparts.
- Body is elongated wedge-shaped.
- Magnification is required.
- Color ranges from light yellow to straw.
- Peak populations usually occur during June and July.
- Oil should be effective in suppressing rust mites.

Citrus Rust Mite Damage to Fruit

Citrus snow scale. *Unaspis citri* (Comstock)
CITRUS SNOW SCALE

- Adult female is 1.5 – 2.25 mm long.
- Female armor is shaped like an oyster shell, brownish purple to black.
- Immature male scale armor is white with parallel sides and three longitudinal sections, one central and two marginal ridges.
- Adult male is winged and light yellow.
- Citrus snow scale primarily attack the trunk and large limbs, but can be found on leaves, twigs and fruit.

APHID DAMAGED TWIG

APAIDS

- Produce live young asexually allowing for rapid population increases.
- Infest newly expanding citrus terminals, sucking sap from the growing leaves and stems.
- Does not produce significant damage to mature trees but can damage young trees.
- Honeydew is excreted by aphids stimulating the growth of sooty mold that may reduce photosynthesis.
- Under biological control by ladybeetles, hoverflies and lacewings.
- Populations usually decline under high summer temperatures and during periods that lack new flushes.

WHITEFLIES

- Brown Citrus Aphid, *Toxoptera citricida* (Kirkaldy)
- Citrus Whitefly, *Dialeurodes citri* (Ashmead)
**Citrus Whitefly Nymph**

- Adults are about 1-2 mm long, moth-like with males smaller than females.
- Wings are covered with a white waxy powder, abdomen is yellow.
- Eggs are laid primarily on the underside of the leaf, yellow in color and on stalks.
- Populations increase on spring and summer leaf flushes.
- Whiteflies produce honeydew which supports the growth of sooty mold.
- Attacked by fungal pathogens and various wasps.

**MEALYBUG**

- White with a segmented body which is covered by a powdery wax covering.
- Underneath the covering is a yellowish, oval soft body.
- Wax covering will increase with age.
- Adult female is approximately 3 mm in length and will produce 300-600 eggs.
- Nymphs are light yellow to cream.
- Common in the spring and early summer and are found in sheltered locations within the citrus tree.
- Produce large amounts of honeydew.

**ASCHERSONIA FUNGI**

- Infects whitefly nymphs, producing a red or yellow raised growth in and over the nymphs.
- As the fungi ages, the colors will fade.
- Friendly fungi.

**INSECT CONTROLS**

- Generally, oil sprays can provide good control if applied frequently. Oil has a number of advantages over conventional pesticides because it is less disruptive to natural enemies, insects do not develop resistance to it, it has a low toxicity to vertebrates, and it breaks down readily in the environment.
- Parasitic wasps, ladybeetle and lacewing larvae, and adult ladybeetle are some of the more common beneficial insects to watch for.
- Insecticidal Soaps: Among the more common brand names are Safer Insecticidal Soap™, M-pede™ or Concern Insect Killing Soap™. [Trade names given here are not intended as an endorsement, but are given as examples of typical products.] Not only is it a good idea to read and follow all label directions - it’s the law.
Citrus Nutritional Deficiencies

Nitrogen Deficiency

- Deficiency is expressed by light green to yellow foliage over entire tree in absence of any distinctive leaf patterns
- As deficiency progresses leaves become lighter in color
- Nitrogen deficiency will limit tree growth and fruit production
- Excessive nitrogen produces excessive vegetative growth at the expense of fruit production, reducing fruit quality

Nitrogen Deficiency on Aging, Senescing Leaves

- Nitrogen deficiency is associated with senescing foliage which can develop a yellow-bronze appearance prior to leaf abscission

Potassium Deficiency

- 3 levels of potassium deficiency with the smallest fruit being the most deficient
Fruit are smaller, have smoother, thinner rinds and may be subject to splitting and/or fruit drop.

Potassium deficiency is likely to occur on calcareous soils due to elemental antagonism.

Easily corrected by soil applications except in areas of extremely high soil pH.

- **Potassium Deficiency**

- **Magnesium Deficiency**

  - First symptom is a yellowish green blotch near the base of the leaf between the midrib and the outer edge.
  - The yellow area enlarges until the only green remaining is at the tip and base of the leaf as an inverted V-shaped area on the midrib.
  - Dolomite will correct mild foliage symptoms in soils with low to neutral pH.
  - Magnesium deficiency occurring in calcareous soils may have to be corrected with foliar sprays.

- **Manganese Deficiency**

  - Deficiency appears as dark green bands along the midrib and main veins surrounded by light green interveinal areas giving a mottled appearance.
  - As severity increases, the light green interveinal areas give way to a yellow-bronze coloration.
  - Deficiency occurs on calcareous soils.
  - Soil and foliar application may be effective in correction of manganese deficiency.

- **Zinc Deficiency**
Zinc Deficiency
- Early stages appear as small blotches of yellow between green veins on the leaf
- With severe deficiency, leaves may become increasingly yellow except for the green veinal areas
- Under severe conditions, leaves will also be small with narrow pointed tips on terminal growth
- Foliar fertilizer applications are usually recommended for correcting zinc deficiency
- Trees with citrus blight also show leaf zinc deficiency

Iron Deficiency
- In mild cases, leaf veins are slightly darker green than interveinal areas with symptoms appearing first on new foliage
- In severe cases, interveinal areas become increasingly yellow with the entire area eventually becoming ivory in color
- Usually a greater problem on calcareous soils
- Trees which have been flood damaged will also show iron deficiency

FRUIT SPLIT
- Heavy Rainfall in September/Oct.

Bird/Thorn Puncture
- May have single to multiple puncture sites that vary in depth and size
- In severe cases, the fruit may fall from the tree before reaching maturity

ANY QUESTIONS