



Growing Healthy Citrus in the Backyard

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Backyard Culture is a Little Different than Commercial Culture

- We usually don't use tractors
- We certainly don't use helicopters
- We don't need "maximum" yields

- But, some things are the same
 - diseases
 - insects and mites
 - irrigation requirement
 - fertilizer requirement



Things to Consider

- Site Selection
- Varieties
- Planting
- Watering
- Training, Pruning and Thinning
- Fertilizing
- Sanitation
- Pests and Diseases
- Harvesting and Storage

CHALLENGES FOR BACKYARD GROWERS

- Limited Space – a typical backyard cannot accommodate many full sized fruit trees.
- Limited Variety – if you can manage to squeeze in two full size fruit trees, you only get to eat two types of fruit.
- Overproduction – a regular family will be hard pressed to use a huge amount of one type of fruit
- Very Short Productive Season – comes at once, over a few short weeks, and then there is nothing!
- Difficulty in Harvesting – collecting fruit that is sitting 15 or more feet above the ground is not an easy task, even with the right equipment.
- Difficulty in Maintaining – spraying a full size tree is a nightmare, and may be physically impossible in the context of a backyard scenario. Pruning a very tall fruit tree is also a challenge.

Oranges

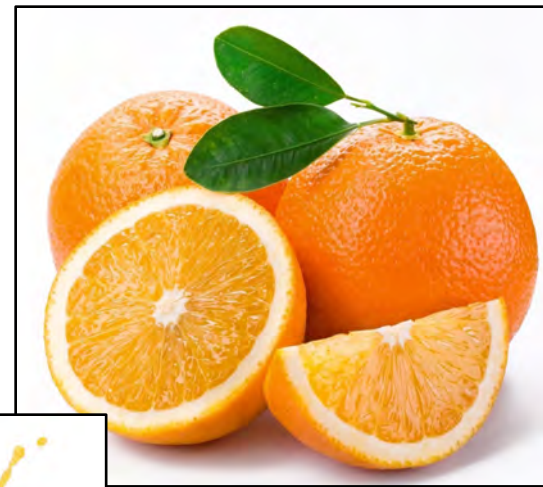
Navels:

- Washington: Large seedless fruit, most commonly eaten fresh (not juiced).
- Suited to cooler production areas, does not produce high quality fruit in the desert.
- Produces well in SD County, OC, Riverside, San Bernardino, & Redlands areas.
- Fruit splitting in the fall/winter is a common problem & often related to irrigation practices weather conditions
- Harvested from Jan- April in home gardens.



- **Cara Cara: (LEFT)**
- this navel orange has reddish pink flesh.
- The pink color is similar to that of the red grapefruits- it is similar to the Washington navel in taste & harvest time (Feb.- March).
- **Lane Late:** ripens late in the season, extending the harvest of navels into early summer.

- **Valencia orange:** Often called “juice” oranges.
 - Thin skinned, smaller fruit with very juicy pulp. **Tends to alternate bear.**
 - Ripens later than Navel (early summer through fall) - fruit store well on the tree but may re-green in the summer.
 - Seedless variety is Delta.



- **Blood oranges:** Moro (better color) and Tarocco (better flavor) do well in inland and coastal areas.
 - Almost seedless fruit w/a deep red coloration. Flavor is berry-like.
 - Attractive spreading tree.



Grapefruit

- Depending on the variety, fruit mature starting as early as November.
- Depending on the location, some fruit can hold on the tree until September.

- **Flame**, (RIGHT) red fleshed & has a red blush on the skin like the other red/pink grapefruit. It ripens in late summer in the Riverside area.



Oroblanco, (LEFT) grapefruit-pummelo cross, is very sweet, juicy & low in acid. It ripens in Jan. & holds well into early summer.

- **Melogold**, sibling to Oroblanco, is white fleshed, seedless like Oroblanco but juicier.

Melogold



Cocktail Grapefruit



- **Cocktail**, a pummelo-mandarin hybrid developed by UCR, very sweet and juicy. Great for juice. Ripens in late-Dec. in Riverside.

- **Marsh Seedless** is white fleshed, juicy w/ fine flavor. High summer temperatures produce best flavor.



Ruby Red Grapefruit

- **Ruby Red** is light pink to red in warm summer climates. Juicy w/fine flavor.

- **Rio Red** has a deep red internal color, excellent flavor & is juicy. Needs summer heat. Does well in lower desert valleys.



- **Star Ruby (LEFT)** has the deepest colored of the red grapefruit w/a less acidic fine flavor. Needs some heat to develop the best flavor but it is not suitable for the desert. This variety is characterized by white to yellow flecks in the leaves. It ripens in early summer.



Lemons

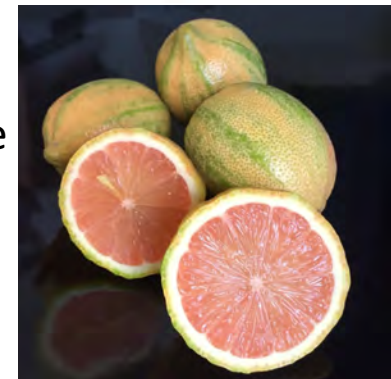
- **Lisbon lemon:** Has some cold resistance, very heat tolerant, vigorous & thorny tree. Highly productive, high quality fruit. Fruit mature mostly in fall-winter. On the coast, trees can bear some fruit year round.



- **Eureka lemon:** Cold sensitive, nearly thornless, very attractive tree, productive - high quality fruit. Tree bears year round on the coast, fall & winter in the low desert valleys, & winter-spring production in the inland Riverside areas.



- **Variegated Pink-** a sport or mutation of Eureka that has variegated (green-and-white striped) leaves & immature fruit striped green & cream, mature flesh is light pink plus the tree itself is smaller making it very garden-friendly.



- **Improved Meyer lemon:** Although it is considered to be a lemon, it is probably a lemon-sweet orange hybrid. Thus it is fairly cold resistant, similar to sweet orange. Fruit are round, thin skinned, & almost orange in color. Very juicy, with less acid than other lemons. Bears year round.

Regular Lemon Meyer Lemon



Limes

- **Bearss Lime (Tahitian-type Lime):** Seedless fruit, much larger and milder flavor than the Mexican lime. Not as cold hearty as a lemon. Of the limes, this is the most suitable to Southern California.



- **Mexican Lime (Key Lime) -LEFT:** Very frost sensitive and is only suited to more tropical areas that do not receive any frost (coastal areas). Thornless Mexican Lime is also available and is equally frost sensitive.

- **Limequat (lime X kumquat hybrid):** Lime-like flavor that can substitute for a lime. This tree is more frost tolerant and can be planted in areas that receive an occasional frost.

Limequat



Mandarins (Tangerines) & Tangelos

- **Satsuma Mandarin**- easy-to-peel and seedless fruit.
- Varieties, Dobashi beni, Okitsu wase & Owari all thrive in cooler parts of So Cal.
- Satsuma is sensitive to high temperature -are the most cold hardy citrus trees of commercial importance.
- They are also the earliest fruit to ripen.
- Fruit from both mature at the end of Oct. Owari ripens a month later.
- If fruit are left on the tree they rapidly becomes puffy & insipid, however, fruit store well off of the tree.
- Some Owari strains have degenerated into poor trees due to its ability to sport readily producing new strains that are not productive.
- Most varieties tend to alternate bear.



- **Gold Nugget** is a seedless variety, developed & released by UCR that has a sweet, rich flavor w/a somewhat bumpy skin that peels easily. Ready in March & holds well through Aug.



- **Pixie**, also developed by UCR, has a sweet, mild flavor, without seeds, holds well & peels easily. In the IE, fruit can be harvested as early as mid-Feb. & go through early June.



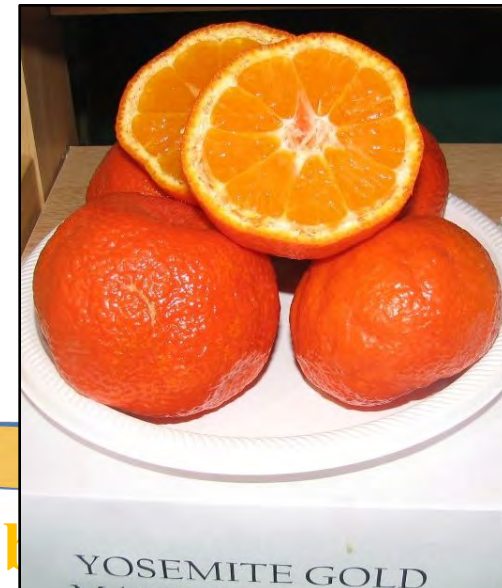
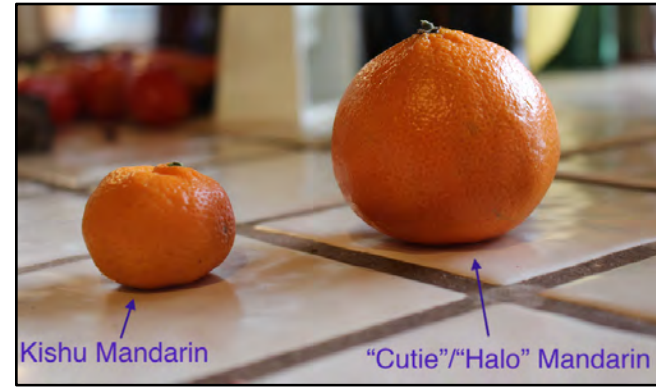
- **Clementine** (Algerian) has bright orange, juicy flesh w/sweet, very rich flavor. Bears from Dec.-Feb. Must have Dancy pollinator for good fruit production.



- **Fairchild** is very juicy w/richly sweet flesh & seeds. Needs Temple (Royal) pollinator.



- **Seedless Kishu** has small fruit slightly larger than a golf ball, mild, sweet, truly seedless, quite juicy & extremely easy to peel. The fruit matures in Nov. & holds until Jan.
- **Shasta Gold™**- recently developed- The flesh is seedless, bright orange & juicy. The flavor is richly sweet. In the inland are, the season is mid-Feb.-mid-March & holds well on the tree into April or May.
- **Tahoe Gold™** -release by UCR. The flesh of the fruit is seedless, bright orange, finely-textured & juicy. The flavor is rich & sweet. Its season is mid-Jan.- midFeb.
- **Yosemite Gold™**-The flesh is seedless, bright orange, finely-textured & juicy. The flavor is richly sweet. The season is Jan.-mid-March & holds well on the tree into April.



Tangelos (a cross between grapefruit and mandarins)

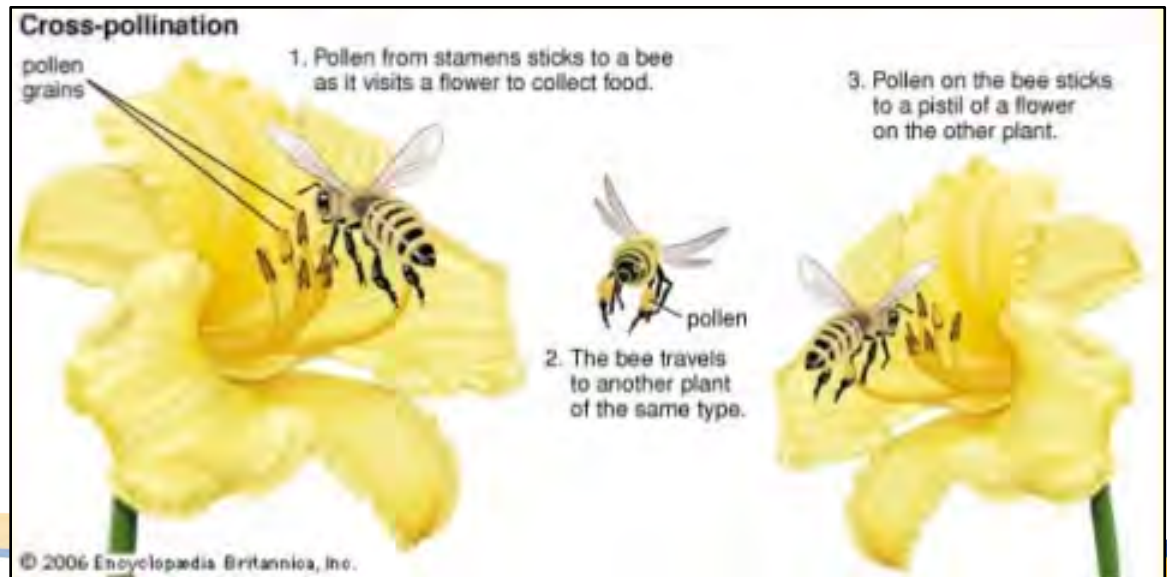
- Orlando tangelo: Fruit ripen in November-January.
 - Fruit peels poorly and it contains many seeds.
 - May need pollinator for more fruit production.



- Minneola tangelo: Large, red-orange fruit; peels well; few seeds; rich tart flavor.
 - Fruit ripen in December-February.
 - May need pollinator for better fruit production.

- Some tangelos & mandarins need cross-pollination for best fruit production
 - Minneola tangelo: Temple, Dancy, Kinnow, or Clementine
 - Orlando tangelo: Temple, Dancy, or Kinnow
 - Clementine mandarin
 - Fairchild mandarin: Orlando, Clementine, Kinnow, or Temple (Royal)

- **cross-pollination**- The transfer of pollen from an anther of a flower of one plant to a stigma of a flower of another plant of the same species



Kumquats

Meiwa and Nagami

- These are the most cold-hardy of all citrus types.
- Tree foliage can withstand temperatures below 20° F & therefore can be grown in areas that are too cold for most citrus.
- Fruit, however, are more cold-sensitive.
- Trees are small, less than 12 ft tall. Fruit are eaten whole, peel & all.
- Meiwa have round fruit w/a sweet rind & flesh, excellent for eating. Nagami have oval-shaped fruit w/a sweet rind & tart flesh.
- Nagami is the most common variety found in grocery stores.
 - Nordman Seedless Nagami, a new release, has really nice fruit 1 to 1½ inches long without seeds, therefore, especially easy to eat or preserve.





winter burn on pine tree



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Site Selection-Citrus

- Most citrus fruit freeze at 26F (lemons freeze at 29F)
 - Citrus trees freeze at 24F
 - Do not plant in a lawn that requires frequent shallow irrigation
 - Grass competes for water and nitrogen
 - Plant on the south side of the house to increase heat units
 - Plant in a well drained soil
 - Hard to do if you have a clay soil
- Some citrus need warmer temperatures in the summer to ripen the fruit

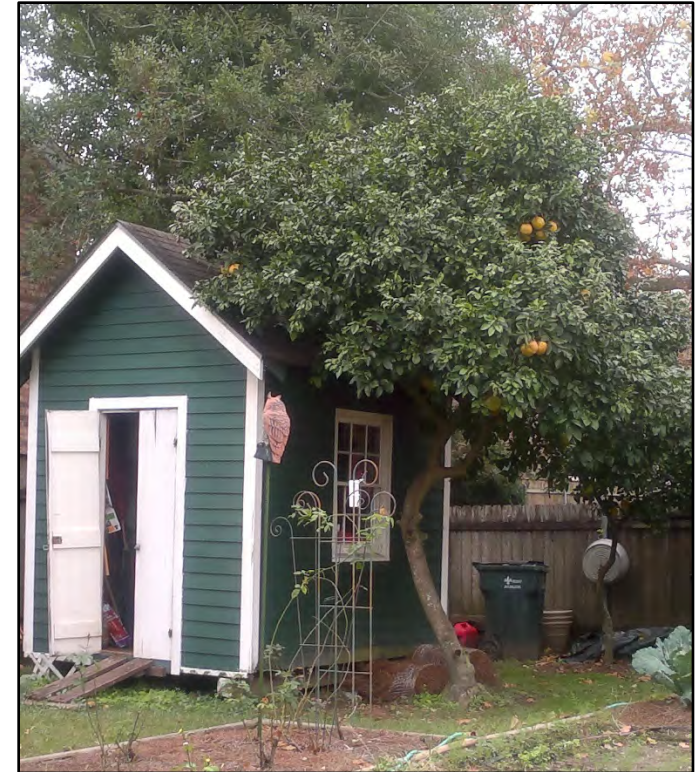
- Plant in Spring or Fall (after February)
- Don't plant it too deep. Don't add fertilizer/mulch to the backfill.
 - Don't add anything to the back fill soil unless you have an adobe clay soil
- Protection from sunburn is why citrus often have their trunks painted white & come from the grower with paper protection around the trunk.
 - latex paint diluted 50% with water
 - Do NOT use oil-based paint.



Citrus need Full Sun and Space, this can interfere with the neighbors!



Don't plant lemons too close to the house!



Trees planted too close together





- Grass is very competitive with young trees for resources— especially Bermuda

Mulching



- Apply mulch in spring ~ 6 inches, once a year
- Do not cover the bud union
- *Never use straw or grass as a mulch- reduces oxygen and increases carbon*

Table 1. Riverside Area

Canopy Diameter (ft)	Average Irrigation Water Requirements** (Gallons/Day)											
	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
18	12	12	17	23	28	32	37	37	32	23	15	9
16	12	12	16	21	27	31	36	36	31	21	15	9
14	11	11	15	19	23	27	31	31	27	19	12	8
12	9	9	12	16	20	24	27	27	24	16	11	7
10	8	8	11	13	17	20	23	23	20	13	9	7
8	5	5	8	11	12	15	17	17	15	11	7	4
6	5	5	7	9	11	13	15	15	13	9	5	4
4	4	4	5	7	8	9	11	11	4	7	4	3

**Assumed application efficiency of 75% with values based on long term average water use. Figures in Table 1 may be higher during hot and windy weather.

- Irrigation frequency is influenced by climate



Signs of not enough water

- Cupping of the leaves in the morning
- Will start dropping fruit
- Fruit that is still on the tree will get soft
- Leaves at the end of branches will start to fall



Lemons will always require more water*



- It generally occurs following stresses such as extreme hot weather combined with high winds or drought stress followed by heavy irrigation.
- In both cases, the tree becomes drought stressed and begins to withdraw water from the fruit.
- When the tree is irrigated the dehydrated fruit swell causing them to split



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Fertilization - Citrus

- Trees require nitrogen every year
- First application in late Jan-Feb before bloom
- Second application in May
- Third application in June
- Trees usually need a zinc spray (especially with too much manure for an organic nitrogen program)
- **Suggested application rates of nitrogen**
- (Divide into 2 or 3 applications)
- **1st year:** 1 tablespoon nitrogen fertilizer 3 times per year, per tree.
- **2nd year:** 0.25 lb actual nitrogen per tree
- **3rd year:** 0.5lb actual nitrogen per tree
- **4th year:** 0.75lb actual nitrogen per tree
- **5th year:** 1 lb actual nitrogen each year

Organic Nitrogen Fertilization

- Commercial growers generally use a 50 lb bag of EZ Green (composted chicken manure) per tree per year, 1/2 applied before bloom and 1/2 in late summer
- EZ Green is about 3% nitrogen
- Animal manures usually make zinc deficiency worse, due the high phosphorous content
- Do not apply during bloom!!

“Actual Nitrogen”

- 1 pound of actual nitrogen equals about 5 lb of ammonium sulfate per year, or 100 lb of composted cow manure each year. Organic fertilizers such as manure, bloodmeal, etc. could be applied in the fall under the tree canopy.
- 15-15-15 has 1.5 lbs N in 10 lbs





Zinc Deficiency, Mottling between Veins



Training, Pruning and Thinning -



- DO NOT PRUN-in late February or early March- just before Spring bloom and a growth flush
 - Maximum amount of food stored is in leaves during this time

- Research has shown that you should never use a tree seal.
 - Small pruning wounds (1 inch or less) need not be treated.
 - Tree seals tend to seal in disease and interfere with the tree's natural ability to callous the wound.
- For large pruning cuts lower in the canopy you may treat with Bordeaux mixture.
 - Garden stores may have a prepared Bordeaux mixture. If not, you may prepare Bordeaux mixture paint by mixing equal parts of copper sulfate and hydrated lime with enough water to make a slurry.
 - Read and follow label directions carefully.



Training, Pruning and Thinning - Citrus

- Young citrus (and mature citrus) don't require much pruning, make sure suckers are pruned off from below the graft
- Fruit thinning is not required, but you should expect small pea-sized fruit to fall off in June
- Prune up the skirts 18" to allow you to get under the tree to apply copper bands to repel snails, or sticky materials to catch ants
- Exception: Lemons are topped every two years

Top 10 Pests and Diseases of Citrus (as seen at our office)

- Pests

- Leaf miner
- Ants
- California red scale
- Mealybugs
- Snail damage

- And the most worrisome: Asian Citrus Psyllid

- Diseases

- Phytophthora gummosis
- Phytophthora root rot
- Dry root rot
- Alternaria fruit rot
- Penicillium fruit rot

- An even more worrisome: Huanglongbing disease

Asian Citrus Psyllid

- This tiny insect spreads a bacterial disease in Citrus.
- The disease has killed millions of citrus trees in Florida
- The insect is spreading in California and is now being found in traps in Northern San Diego County groves
- About 1/16" long



Huanglongbing Disease (Citrus Greening)

- Bacterial Disease spread by ACP, plugs up phloem cells
- Only one tree found so far in California (Hacienda Heights)
- But maybe trees grafted from this tree are out there somewhere



Distribution of Asian Citrus Psyllid in California

Affected counties include:
Tulare, Kern, Santa Barbara, Ventura, Los Angeles, San Bernardino, Orange, Riverside, San Diego, and Imperial.





**ASIAN CITRUS
PSYLLID ADULT**



**ASIAN CITRUS
PSYLLID EGGS**



**VARIOUS LIFE
STAGES**



**NYMPHS AND
WAXY TUBULES
WITH HONEYDEW**



We have to keep this insect under control: **this means we have to treat!**

- Conventional growers
 - Winter/spring knock down the adults with a spray of Sevin
 - Summer apply a systemic, Bayer Advanced Tree and Shrub Spray (contains imidacloprid)
 - Organic growers
 - Pyganic (3 applications 10 days apart)
 - Plus 1% Oil (nr 415 or nr 440)
- Or (other things being tested by farm advisor Jim Bethke)

There is no cure for this disease



- In the future:
 - Spinach gene inserted into citrus genome makes citrus resistant to HLB
 - Troyer citrange is resistant...Can we breed it into an edible fruit?

- *Tamarixia radiata*, a tiny parasitic wasp has been imported into CA from Pakistan
- Populations have been released in Los Angeles, San Bernardino & Riverside Counties (smaller populations are known in Imperial & San Diego Counties).
- Can kill ACP nymphs in 2 different ways.
 - First is parasitism- a female lays an egg underneath a fourth or fifth instar (instar refers to the developmental stage of the nymph).
 - Second - by host feeding. When *Tamarixia* host feeds, the female uses her ovipositor or egg laying tube at the posterior end of her abdomen to stab & mutilate the ACP nymph



Argentine Ant (*Iridomyrmex humilus*)

- Argentine worker ants travel in distinct trails.
- Ants feed on honeydew excreted by soft scales, mealybugs, aphids, cottony cushion scales and whiteflies. Ants can interrupt biological control of these pests.



- Argentine ant Control ants by denying access to the canopy.
- Apply a band of sticky material to base to trunk that mechanically impedes ants.

Ants feeding on twigs, bark, leaves and honeydew excreted by other insect pests.

- Prune the canopy up 30 inches off ground.
- Use boric acid/sugar baits that the worker ants can take back to the nest and kill out the queen.



Mining trails through leaves and young twigs

- Citrus leafminer



How to Treat for Citrus Leaf Miner

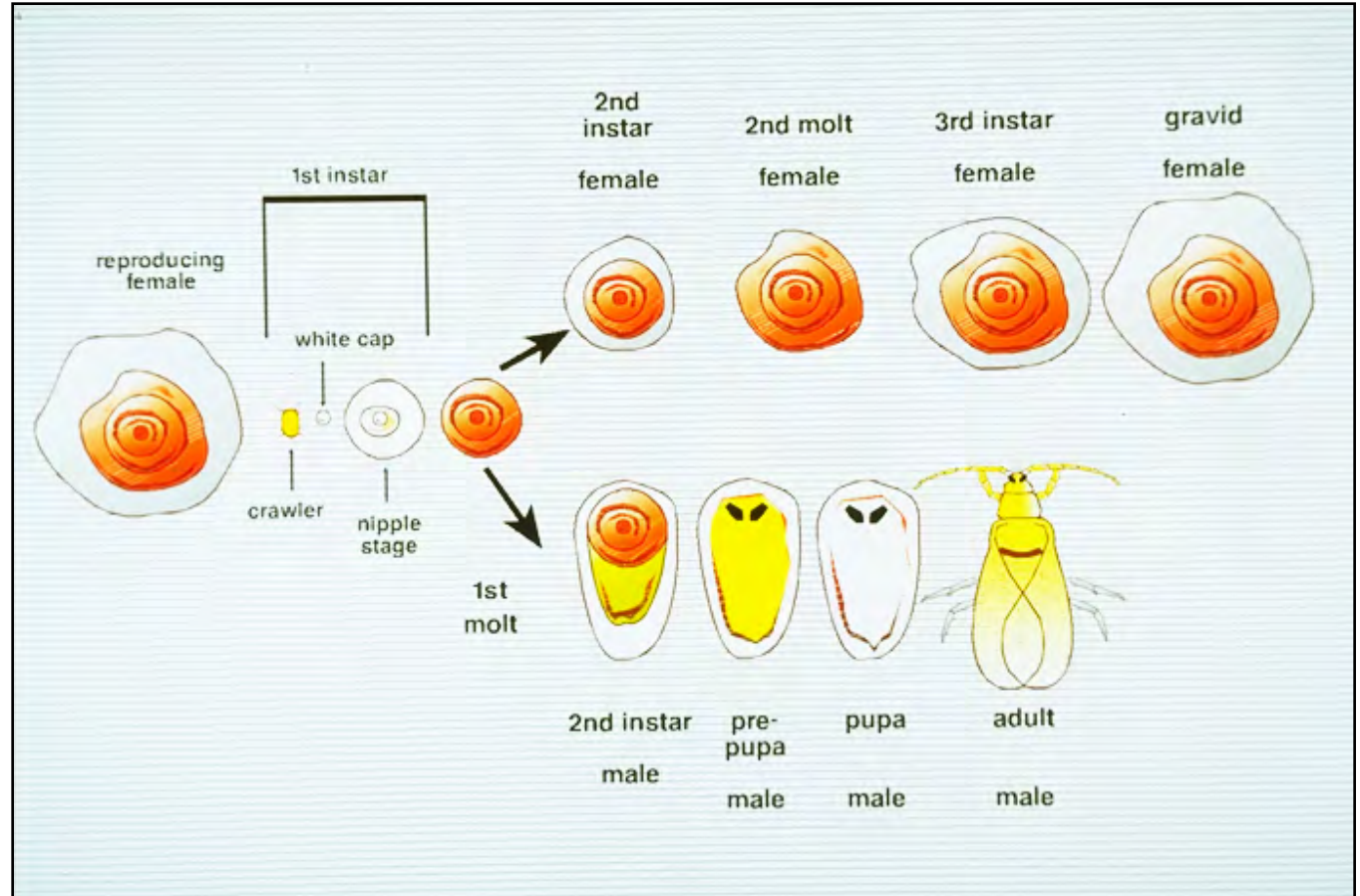
– Mature Orchards:

- **Treatments are not necessary for mature trees.**
- The foliage will look bad, but damage will NOT affect yield.
- Insecticide treatments will disrupt natural enemies
- We have released natural enemies (parasitic wasps) and they are spreading naturally

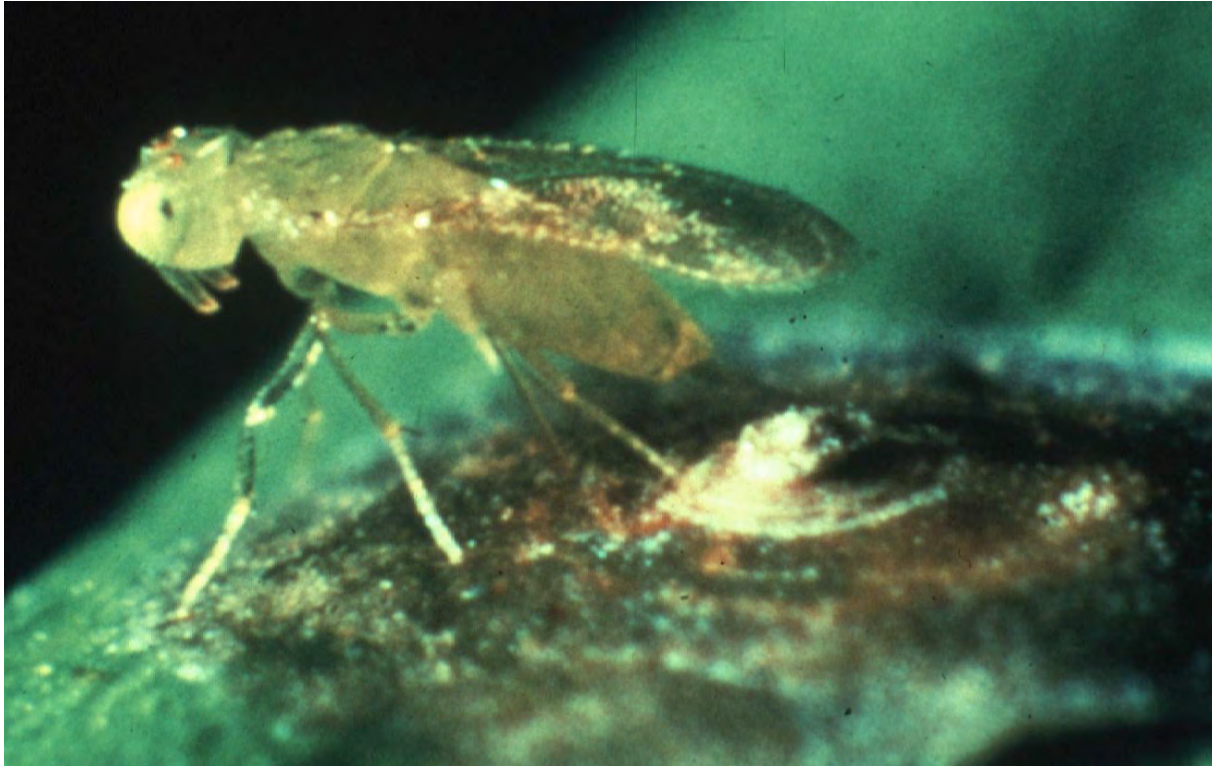
-New plantings and citrus nurseries:

- **Treatments are needed for the first two years**
- New plantings rely on systemic imidacloprid (Bayer)
- Nurseries rotate between Admire and foliar insecticides (Assail, Intrepid)

Citrus Red Scale



Parasite (*Aphytis melinus*) laying eggs into red scale



Fruit and leaves covered with honey dew and sooty mold. Mealybugs present.

- **Mealybugs.**
- Soft, oval distinctly segmented insects covered with a mealy white wax.
- Adults about 1/8 to 1/4 inch long. Mealybugs extract plant sap reducing tree vigor.
- If a cluster of mealybugs feeds along a fruit stem, fruit drop can occur. Natural enemies usually control.



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- **At home hand pick or wash off insects.**
- **Mealybug destroyer (a predator) is available commercially for purchase and release**



Adult Mealybug Destroyer

Mealybug Destroyer Larvae (*Cryptolemus*)



Citrus Mealybug



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Comstock Mealybug



Brown Garden Snail



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Holes in leaves and fruit and slimy trails

- Brown garden snail (*Helix aspera*), gray garden slug (*Agriolimax reticulata*)
- Brown garden snail is about 1 inch diam.
- With distinct color pattern; gray garden slug is a snail relative, lacks shell.
- Most active at night and early morning when it's damp.

Manage by skirt pruning and trunk treatment. Release predatory decollate snails in counties where it is legal. Copper barriers, such as trunk-banding of citrus trees, can be effective.

Skirt-Pruned Citrus





Copper band on citrus (see snails below)



Decollate Snail feeds on young brown garden snails and their eggs

- Will establish best in moist environments & can flourish if they have sufficient food in the form of leaf litter & fallen fruit.
- The best time to release decollates is when the temperatures are above 50 F°
- Once established, will nearly eliminate the brown garden snail population in 4 to 6 years.



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Brown Rot

- Grayish brown firm and leathery spot
- Pungent odor
- Fine white spore on rind
- fungi can overwinter in dried infected fruit called mummies or in infected twigs.
 - mummies may remain hanging in the trees or be scattered on the orchard floor.



Spread

- The fungus resumes growth in the spring, providing inoculum for blossom infections.
- 2 types of spores may be produced:
 - Ascospores are only produced on mummies which have fallen to the ground and are at least partially covered with soil.
 - Conidia are produced in abundance on **mummies and infected twigs and may be spread by wind and rain.**

CONTROL

- During wet seasons when favorable temperatures prevail, brown rot can be difficult to control.
- A grower with a small orchard may wish to remove mummies and infected twigs and either burn them or bury them deep in the soil.

Phytophthora gummosis



Leaves turn yellow and drop. Beads of sap ooze from trunk lesions. Gumming is more pronounced in spring. Bark can harden, dry and crack.

- When infection is just above the bud union it is often called foot rot; when infection is higher up on the trunk it is often called gummosis.
- When it spreads down into the crown, it is referred to as foot rot. Fungus infects the bark and phloem of the tree trunk and may spread to crown and woody roots.
- **Keep trunk dry.** Do not allow sprinkler water to hit the trunk.
- Scrape away all diseased bark and include a buffer strip (about 1 inch) of healthy light brown to greenish bark around margins. Allow to dry. Repeat if infection recurs. Keep mounded soil and water away from trunk. Improve ventilation by removing branches that touch ground.
- Avoid injuring bark with lawn mowers, weed whackers (the worst) and pruning tools, since wounds give fungus an easy entry.

Phytophthora gummosis is sap oozing from small cracks in the infected bark, giving the tree a bleeding appearance



- The gumming may be washed off during heavy rain.
- The bark stays firm, dries, and eventually cracks and sloughs off.
- Lesions spread around **the circumference of the trunk**, slowly girdling the tree.
- Decline may occur rapidly within a year, especially under conditions favorable for disease development, or may occur over several years.
- The Phytophthora species causing gummosis develop rapidly under moist, cool conditions. Hot summer weather slows disease spread and helps drying and healing of the lesions.
- In addition to improving the growing conditions, you can halt disease spread by removing the dark, diseased bark and a buffer strip of healthy, light brown to greenish bark around the margins of the infection.
 - Allow the exposed area to dry out. You can also scrape the diseased bark lightly to find the perimeter of the lesion and then use a propane torch to burn the lesion and a margin of 1 inch (2.5 cm) around it.

The leaves have been gradually dropping from my tree, the leaves on the tree are yellow, the canopy is so thin I can see the sky through it and the leaves tend to be very small.

What is going on?



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Phytophthora root rot



Leaves turn yellow and drop. Root bark of infected roots slides off easily when pinched. Feeder roots destroyed.

- **Phytophthora root rot (*P. citrophthora*), symptoms may be difficult to distinguish from nematode, salt or flood damage.**
- Caused by the same fungus that causes gummosis, but it infects the root system in this disease. Survives in soil a long time. Disease can occur when water is in direct contact with the base of the trunk and the trunk is allowed to stay wet. Shorter less frequent irrigations may help if damage is not severe. Avoid waterlogging. If damage is severe, remove tree.
- Use tolerant rootstock such as trifoliate orange, Troyer/Carrizo citrange or C-32/C-35. Do not plant citrus in the lawn where it will be watered too frequently.

Methods of Moving *Phytophthora*

Boots & Equipment



Dry Root Rot



Dry Root Rot

- Caused by *Fusarium solani*
- This fungus infects weak roots and trunks injured by fertilizer burns, gophers, weed wacking
- Also infects roots weakened by poor graft unions or any other type of major girdling action
- The tree can go from healthy to dead in six weeks due to xylem plugging in the crown
- **There is no cure, the tree must be removed**

Alternaria rot in a split navel orange



Internal black rot in navel orange fruit. Rot starts at stem end, extends into core. Can occur on lemons in storage.

- **Alternaria rot (*Alternaria citri*)**
- **A fungus disease. Also known as black rot on navels. More of a problem when the navel is split. Preventing stress (especially drought stress) reduces susceptibility. No chemical control.**

Penicillium

blue mold and green mold



Whitish mycelium on fruit; blue and/or green spores appear on fruit

- Blue mold (*Penicillium digitatum*) or Green mold (*P. italicum*)
- May occur on injured fruit in the field but more often is a storage, postharvest disease.
- Early infections are almost impossible to detect. Easily recognizable when whitish mycelium and blue or green spore appear. Both types may occur together. To reduce infection, do not pick wet fruit and handle fruit carefully during picking. Immediately discard infected fruit and wash all stored fruit nearby in soapy water.
- Do not pick up fruit on the ground as they may have tiny injuries that quickly may become infected.

Stem End Rot

- Softening of tissue around button/bottom of fruit
- Rapid decay down axis
- Abundant rainfall/moisture





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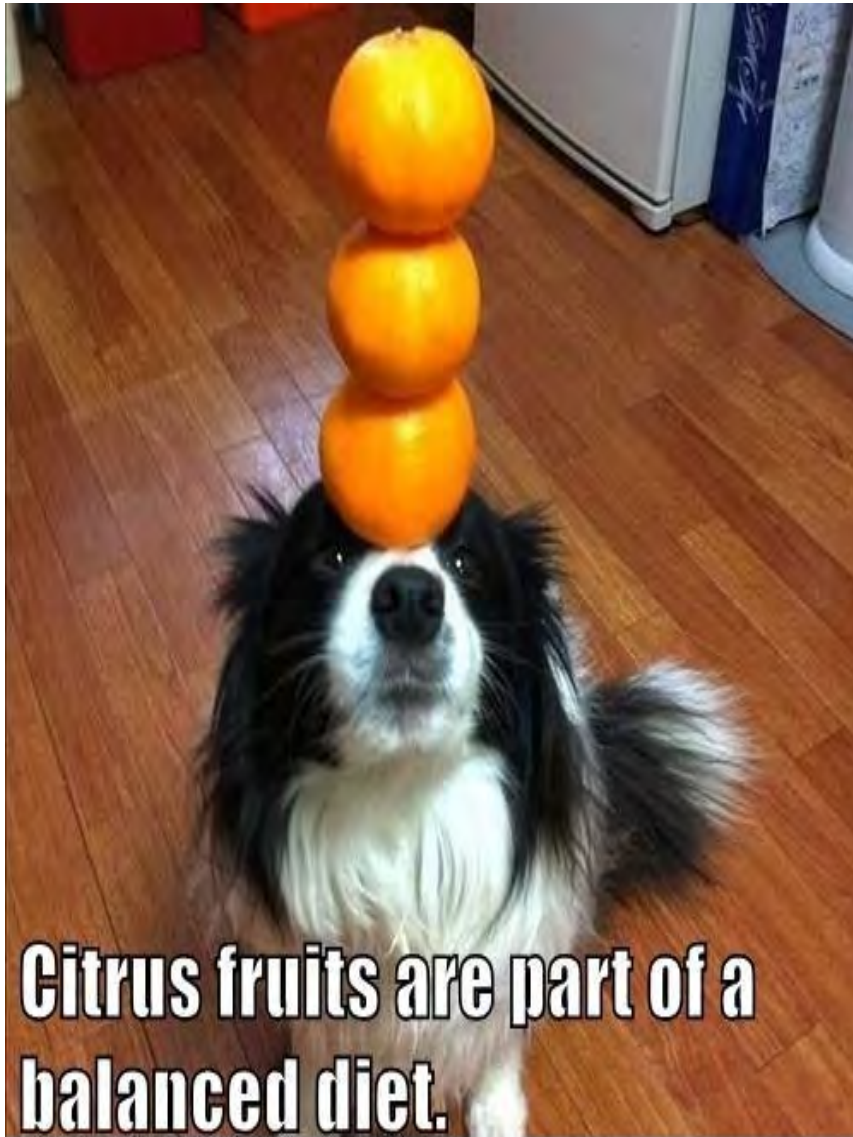
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Questions??



Citrus fruits are part of a balanced diet.



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