

Small Scale Citrus Farming – 2022

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COLLEGE OF
AGRICULTURE
& LIFE SCIENCES

COOPERATIVE EXTENSION
Yuma Agricultural Center



Topics Covered

1. Marketing
2. Labor
3. Site Selection
4. Planting
5. Varieties
6. Rootstocks
7. Pruning
8. Irrigation
9. Fertilization
10. Frost Protection
11. Pests



Marketing

- How will you sell the fruit?
 - Roadside sales
 - Sale to grocery store or another outlet
 - Pick your own
 - Agrotourism
 - Rent-a-tree



Labor

Who will pick the fruit?



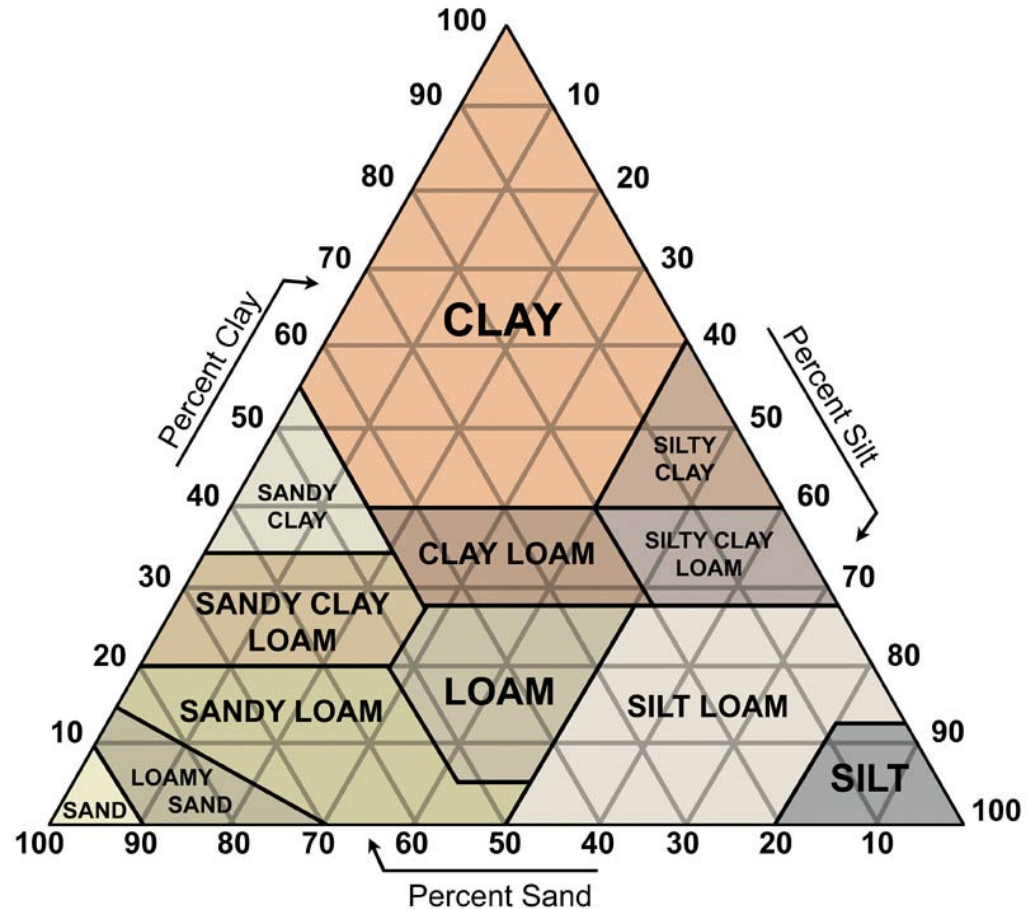
Site Selection

- Low temperature is the most critical factor affecting the extent of citrus growing worldwide..
- Microclimates should also be taken into consideration. These include:
 - Slopes, and depressions.
 - Presence of other frost sensitive plants (Ironwood –*Olneya tesota*)



Soil Texture and pH for citrus

- Soil type is important. The best are deep sandy to sandy loam soils.
- Soils with over 50% clay may have drainage problems.
- Soil pH up to 8.5, but lower is better.



Site Selection

- Irrigation water is a factor. There must be an adequate supply, it must be of good quality,
- Water must be accessible.
- There must be an affordable delivery system,
- There should not be too much competition with urban users.
- Water should not be too saline.



Salt tolerance of fruit Crops.

Relative yield decrease --
%

	0	10	25	50
	Electrical Conductivity (mmhos/cm)			
Date palm	4.0	6.8	10.9	17.9
Fig, Olive	2.7	3.8	5.5	8.4
Grape	1.5	2.5	4.1	6.7
Grapefruit	1.8	2.4	3.4	4.9
Orange	1.7	2.3	3.2	4.8
Lemon, Apple	1.7	2.3	3.3	4.8

- TDS (Total dissolved salts) = mmhos/cm x 640.
- Colorado River Water below Imperial Dam ranges from 650 to 800 ppm (mg/L) TDS
- Therefore, Colorado River Water EC = 1.02 to 1.25 mmhos/cm

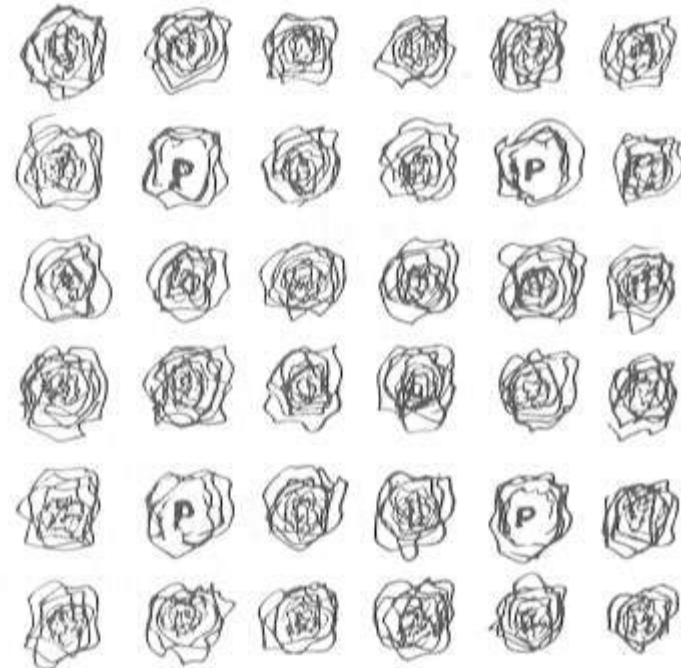
Orchard Design

- The objective of planting density is to maximize the "capture" of sunlight while still allowing for equipment movement throughout the orchard.
- There is no consensus as to the proper tree spacing, either in Arizona or across the world. Spacing ranges from 10 x 10 m (30 ft x 30 ft - 45 trees per acre) to 1.5 x 3 m (4.5 ft x 9 ft -900 trees per acre).

		Between Row Spacing							
		30	28	26	25	24	23	22	20
Within Row Spacing	30	48	52	56	58	61	63	66	73
	28	52	56	60	62	65	68	71	78
	26	56	60	64	67	70	73	76	84
	25	58	62	67	70	73	76	79	87
	24	61	65	70	73	76	79	83	91
	23	63	68	73	76	79	82	86	95
	22	66	71	76	79	83	86	90	99
	20	73	78	84	87	91	95	99	109
	18	81	86	93	97	101	105	110	121
	16	91	97	105	109	113	118	124	136
14	104	111	120	124	130	135	141	156	
12	121	130	140	145	151	158	165	182	
10	145	156	168	174	182	189	198	218	

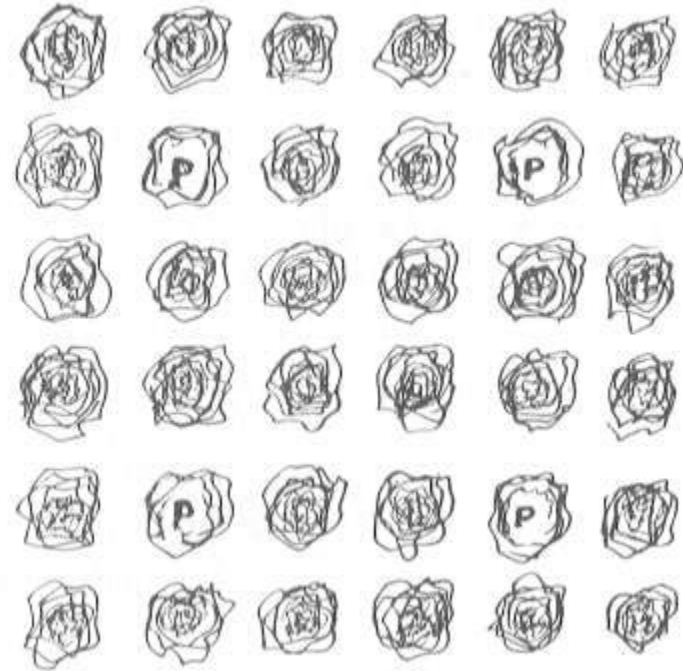
Orchard Design

- Orchards are usually planted in square, rectangular or quincuncial configurations.
- Square configurations are usually wide spacing, because this type allows for ease of spraying and harvesting operations.



Orchard Design

- Square configuration is also used in areas where tree growth is vigorous, or where pruning and hedging equipment is not available.
- Consideration should be given to tree - growth and equipment width, because row middles that are too small will require frequent hedging or will lead to broken scaffold limbs.



Preplant Preparation

- Remove the old grove
 - Use bulldozer to pile up, then burn.
 - Bulldoze out, then chip if burn permits cannot be acquired.
- Timing:
 - Summer or early fall when the tree can be dried out easily following cessation of irrigation.



Preplant Preparation

- Fallow?
 - Can reduce Phytophthora in soil by subjecting it to a dry fallow period.
 - Soil temperatures from 35 to 37C
 - No irrigation for 6 to 12 months
 - Establishment of alfalfa does not reduce Phytophthora



Preplant Preparation

- Deep Tillage (Ripping) as deep as possible
 - Minimum 3 feet
 - Or, as deep as possible to break up hard pan or caliche and/or improve drainage
- Laser Field if possible.
- Apply pre-emergent herbicides if needed



Avoid caliche!



From the surface, excavated down to four feet:
Approx. 12" of top soil, 24" of caleche, 12" soil

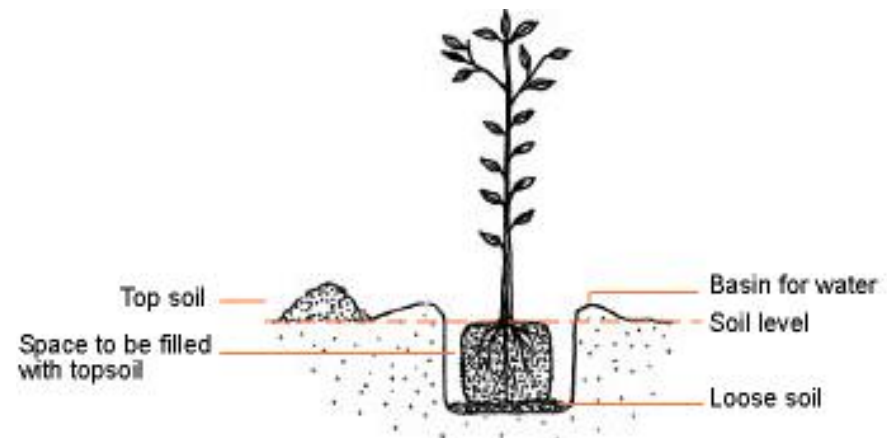
Orchard planting

- Trees must be ordered 1 to 2 years in advance.
- Fields are marked out with stakes, straws or gypsum prior to planting.
- Tree holes are dug by hand or with augur.
- Hand crews cost 1/2 as much as an auger and can plant a tree every 30 to 40 seconds.
- Can the labor be found?



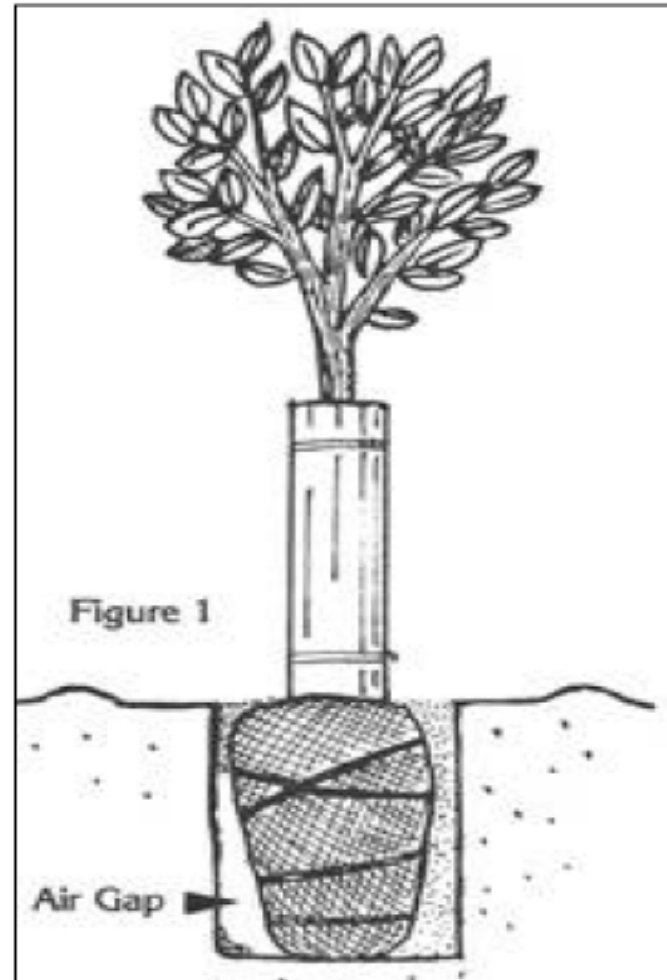
Orchard planting

- String around the trunk is cut, and burlap is pulled down over the shoulder of the root ball. Or, container is removed. No need to remove "sock"
- Tree is placed in the hole at the same level as it existed in the nursery to avoid soil diseases and water loss from the root ball.
- Hole is refilled with soil. **Do not overfill!**
- Organic matter may be added but is not necessary.
- Tree is tamped down to eliminate air pockets.
- Field is irrigated.



Air Pockets and Wraps

- Check trees to see if they have air pockets
 - Probe soil around tree with a soil probe
 - If gaps exist, collapse the gap with a 4-foot long $\frac{3}{4}$ inch rod.
 - Irrigate again.
- Wrap tree with trunk wrap
 - White, corrugated cardboard.



Air gaps often occur when a tree is shovel planted due to the taper of the root ball.

Planting Depth

- Always plant at grade or above. Do not cover the bud union with soil. This lessens the chance of root rot.
- No need to bank dirt around the trunk - water will not hurt a tree trunk.
 - Assuming that the trunk is allowed to dry between irrigations.
- Mulch may be used to cool soil, but not a necessity, as the canopy should do so.



Varieties

- Choose varieties that are unique or unusual in some way.
 - Unusual flavors
 - Unusual colors
 - Varieties that appeal to certain ethnic groups
 - Heirloom varieties
 - Varieties that ripen early or late



Varieties with unusual flavor

- Blood oranges
- Pummelos
- Sweet lemons
- Late mandarins



Varieties with unusual color

- Blood oranges
- Cara Cara navel
- Red grapefruit
- Red pummelos
- Variegated pink lemons



Varieties that appeal to certain ethnic groups

- Sweet lemons
- Kumquats
- Pummelos



Heirloom varieties

- Local navels or sweet oranges
- Fairchild tangerine
- Algerian tangerine
- Marsh grapefruit



Varieties that ripen early or late.

Citrus Variety	Primary Harvest Period																							
	Aug		Sep		Oct		Nov		Dec		Jan		Feb		Mar		Apr		May		Jun		Jul	
	1	15	1	15	1	15	1	15	1	15	1	15	1	15	1	15	1	15	1	15	1	15	1	15
Navel Oranges																								
Fukumoto, Beck-Earli, Bonanza, Fisher, Newhall							■	■	■	■	■													
Washington, Atwood, Robertson, Spring, Summer Gold, Thomson								■	■	■	■	■	■											
Cara Cara										■	■	■	■											
Lane Late, Autumn Gold, Barnsfield, Chislett, Navelate, Powell											■	■	■	■	■	■								
Sweet Oranges																								
Marrs							■	■	■	■	■	■	■											
Hamlin							■	■	■	■	■	■	■											
Diller, Pineapple, Salustiana, Trovita,										■	■	■	■	■	■									
Valencia Oranges																								
Campbell, Delta, Olinda, Midnight														■	■	■	■	■	■	■	■	■	■	■
Blood Oranges																								
Moro											■	■	■	■	■									
Ruby, Tarocco												■	■	■	■									
Sanguinelli												■	■	■	■	■								
Mandarins (Tangerines)																								
Clementine								■	■	■	■	■												
Fairchild								■	■	■	■	■												
Daisy, Dancy, Ponkan									■	■	■	■												
W. Murcott Afourer, Tango										■	■	■	■	■										
Kinnow											■	■	■	■	■									
Gold Nugget												■	■	■	■	■	■	■						
Tangelos and Tangors																								
Orlando								■	■	■	■	■												
Minneola										■	■	■	■	■										
Temple, Ellendale, Ortanique										■	■	■	■	■										

Citrus Variety	Primary Harvest Period																							
	Aug		Sep		Oct		Nov		Dec		Jan		Feb		Mar		Apr		May		Jun		Jul	
	1	15	1	15	1	15	1	15	1	15	1	15	1	15	1	15	1	15	1	15	1	15	1	15
Grapefruit																								
Duncan										■	■	■	■	■	■	■	■	■	■					
Marsh										■	■	■	■	■	■	■	■	■	■	■				
Flame, Redblush (Ruby Red), Rio Red										■	■	■	■	■	■	■	■	■	■	■				
Texas Star Ruby											■	■	■	■	■	■	■	■						
Pummelo and Pummelo Hybrids																								
Oroblanco							■	■	■	■	■	■	■											
Cocktail							■	■	■	■	■													
Tahitian (Sarawak), Reinking									■	■	■	■	■	■										
Melogold									■	■	■	■	■											
Chandler										■	■	■	■	■	■									
Lemons																								
Eureka		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■							
Lisbon			■	■	■	■	■	■	■	■	■	■	■	■	■	■								
Variiegated Pink Eureka				■	■	■	■	■	■	■	■	■	■	■										
Improved Meyer					■	■	■	■	■	■	■	■	■	■	■									
Ponderosa	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Limes																								
Mexican, Key, West Indian	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Tahiti, Bearss, Persian	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■									
Kumquats, Kumquat Hybrids and other Specialty Citrus																								
Meiwa, Nagami, Fukushu (These can have an occasional fruit year-round)					■	■	■	■	■	■	■	■	■	■	■	■								
Tavares						■	■	■	■	■	■	■	■	■	■									
Calamondin	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Australian Finger Lime	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

Rootstocks

- Most citrus trees are budded to a rootstock.
- Affect vigor, productivity, fruit quality and disease resistance of citrus
- Growers sometimes have a choice of rootstock



Moderately Vigorous and Dwarfing Rootstocks



- Impart good to excellent fruit quality (high juice content, good sweetness, smooth peel, thin peel, good interior and exterior color).
- Best for oranges, grapefruit, mandarins, tangelos and kumquats.

- Types:
 - Standard Types: Sour orange, Carrizo citrange (typically 12 to 16 ft tall)
 - Semi-dwarf: C-35 citrange, Swingle Citrumelo, and trifoliolate orange (8 to 12 ft tall)
 - Dwarf: Flying Dragon, Cuban Shaddock. (less than 8 ft)
- Moderately vigorous to dwarfing, all sensitive to high pH soils, except sour orange.
- Citranges and trifoliolate orange may require iron application, particularly in light, sandy soils.
- Sour orange is best, but not commonly available from Big Box stores because of tristeza disease.

Highly Vigorous Rootstocks



- Rough lemon, macrophylla and volkameriana
- Vigorous, sensitive to cold, and impart poor fruit quality.
- Rough lemon sensitive to *Phytophthora*
- Best for lemons and limes, and Minneola tangelos
- All are standard-sized

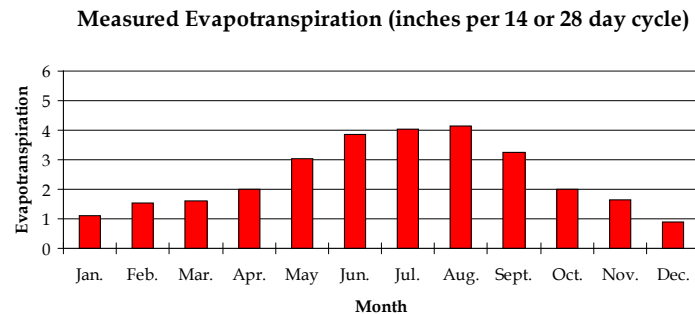
Pruning Citrus



- Citrus trees do not need to be “shaped” annually.
- Pruning is needed in the following cases:
 - To remove suckers or watersprouts.
 - To remove undesirable or dead wood
 - To remove crossing or rubbing branches
 - To allow in light if production is low.

Irrigation Scheduling

- In the desert (in the absence of precipitation), research shows that a mature citrus requires about 1560 mm water per year. This is equivalent to just over 5-acre ft., or (on a 25 x 25-ft. spacing) about 24,000 gallons per year, or 66 gallons per day.



Principals of emitter placement and watering frequency

- Larger wetted areas are preferable to smaller wetted areas
 - Especially in light soils
 - Leads to more extensive root zones
- Best to have 180 to 310-degree pattern
 - Avoid wetting trunk
- Either inward or outward is OK.
- Pattern should be adjustable to compensate for tree growth
- Best to design a system that can irrigate up to 100 gpd.
- Better to water less frequently to minimize salt accumulation



APPLICATION INTERVALS FOR IRRIGATING CITRUS TREES¹

Time after planting	Month				
	Dec - Feb	Mar - Apr	May - Jun	Jul - Sep	Oct - Nov
0 - 1 month	every 2 - 3 days				
2 - 3 months	every 3 - 5 days				
4 months - 1 year ²	14 days	7 - 10 days	5 - 7 days	2 - 5 days	5 - 10 days
1 - 2 years	14 - 21 days	10 - 14 days	7 - 10 days	7 - 10 days	10 - 14 days
3 years or older	21 - 30 days	14 - 21 days	14 days	10 - 14 days	14 - 21 days

¹Adapted from *Irrigating Citrus Trees*, AZ 1151, by Glenn C. Wright.

²Mature trees watered with drip or microsprinkler irrigation should also be watered at these intervals.

Citrus Tree Water Use

Table 1. Orange Water Requirements in Gallons per Day.

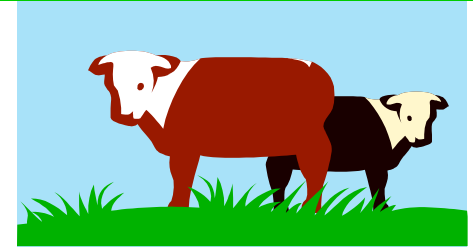
Tree canopy Diameter (ft)	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2	0.1	0.1	0.2	0.3	0.4	0.5	0.6	0.6	0.4	0.3	0.1	0.1
4	0.3	0.4	0.9	1.3	1.6	2.1	2.4	2.2	1.8	1.0	0.4	0.3
6	0.7	1.0	2.1	3.0	3.6	4.7	5.4	5.1	3.9	2.3	1.0	0.7
8	1.2	1.8	3.7	5.3	6.5	8.4	9.6	9.0	7.0	4.1	1.8	1.2
10	1.9	2.7	5.7	8.2	10.1	13.1	15.1	14.0	11.0	6.4	2.7	1.9
12	2.7	3.9	8.3	11.8	14.6	18.9	21.7	20.2	15.8	9.2	3.9	2.7
14	3.7	5.4	11.3	16.1	19.9	25.7	29.5	27.5	21.5	12.5	5.4	3.7
16	4.8	7.0	14.7	21.0	25.9	33.5	38.6	35.9	28.0	16.4	7.0	4.8
18	6.1	8.9	18.6	26.6	32.8	42.4	48.8	45.5	35.5	20.7	8.9	6.1
20	7.5	11.0	23.0	32.9	40.5	52.4	60.2	56.1	43.8	25.6	11.0	7.5
22	9.1	13.3	27.8	39.8	49.0	63.4	72.9	67.9	53.0	31.0	13.3	9.1
24	10.8	15.8	33.1	47.3	58.4	75.4	86.7	80.8	63.1	36.9	15.8	10.8
26	12.7	18.5	38.9	55.5	68.5	88.5	101.8	94.9	47.0	43.3	18.5	12.7
28	14.8	21.5	45.1	64.4	79.4	102.6	118.1	110.0	85.9	50.2	21.5	14.8
30	16.9	24.6	51.7	73.9	91.2	117.8	135.5	126.3	98.6	57.6	24.6	16.9
Avg. Pan Evaporation (in./day)	0.11	0.16	0.21	0.30	0.37	0.45	0.44	0.41	0.32	0.22	0.16	0.1

How to use the table:

Measure the canopy diameter (drip-line to drip-line) of the tree in feet. Using the left-hand column of the table, find the row that corresponds to the appropriate diameter. Using the upper row of the table, find the column for the month for which you want to calculate tree water use. The daily water use will be the value where the row and column intersect. See the example below:

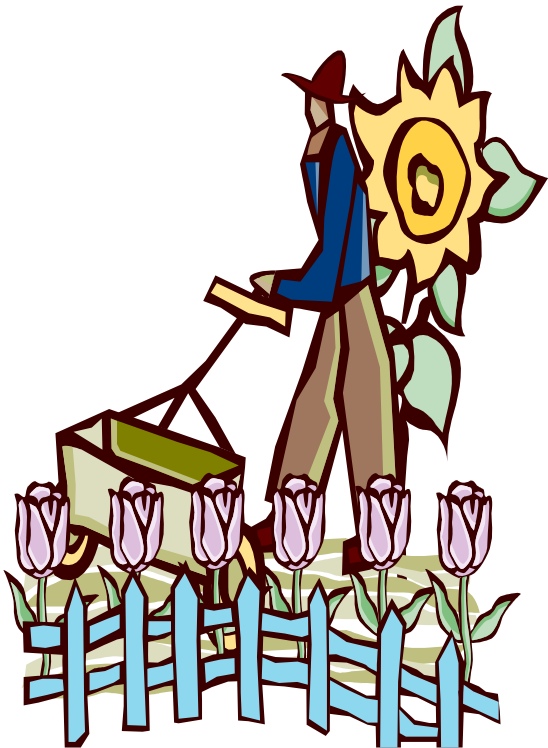
Example:

Fertilizing Citrus



- Always incorporate and water in granular fertilizers.
- Liquid fertilizers good too. They are often sold as blends along with humic acid, proprietary blends of beneficial bacteria, etc.
- NPK are most important, along with Fe and Zn.
- Weeds and grass around tree take up water and nutrients that you might want to provide to the citrus tree. You can have up to 20% yield loss.

How Do I Fertilize My Tree with N?



- N fertilization depends on tree size, not age
 - Newly planted – Small amounts of N as needed, less than 0.25 lb. per year.
 - 2-3 feet tall – 0.25 to 0.50 lb. N per year
 - 4-8 feet tall – 1.00 to 1.50 lb. N per year
 - 10 feet tall or more – 1.75 to 2.5 lb. N per year.
- Fertilize a little more on sandy and gravelly soils.
- Fertilize grapefruits 50% less (1.5 lbs. max.)
- Fertilize lemons 10% more.
- Divide the annual quantity into 3 or more applications.

P fertilization

- P found in most complete citrus foods.
- Or, apply ammonium phosphate (11-48-0, or 18-46-0), triple superphosphate (0-45-0) or several organic sources.
- Apply P only once annually (March, or October), unless you are applying P as part of a complete fertilizer.
- Apply about 0.1 lb. P_2O_5 per tree per year of age, not to exceed 0.5 lbs.

Micronutrients

- Iron and Zinc are most often necessary, Mn on occasion.
- Iron sulfate is not effective when soil pH is between 7.4 and 8.5.
- Chelates or lignosulfonates are the best carriers for micronutrient application.
- Foliar application is common.

Iron and Zinc Deficiency Symptoms

- Interveinal chlorosis
- Occurs on younger leaves
- Zinc deficient leaves are generally small, whereas iron deficient leaves are not.
- Both deficiencies can occur in the same leaf.



Fe, Zn, Mn and Mg deficiency



Fe



Mn



Zn



Mg

Citrus is most likely to survive in the low desert (tan area), and can often survive in protected areas in the mid-altitude desert (brown area)

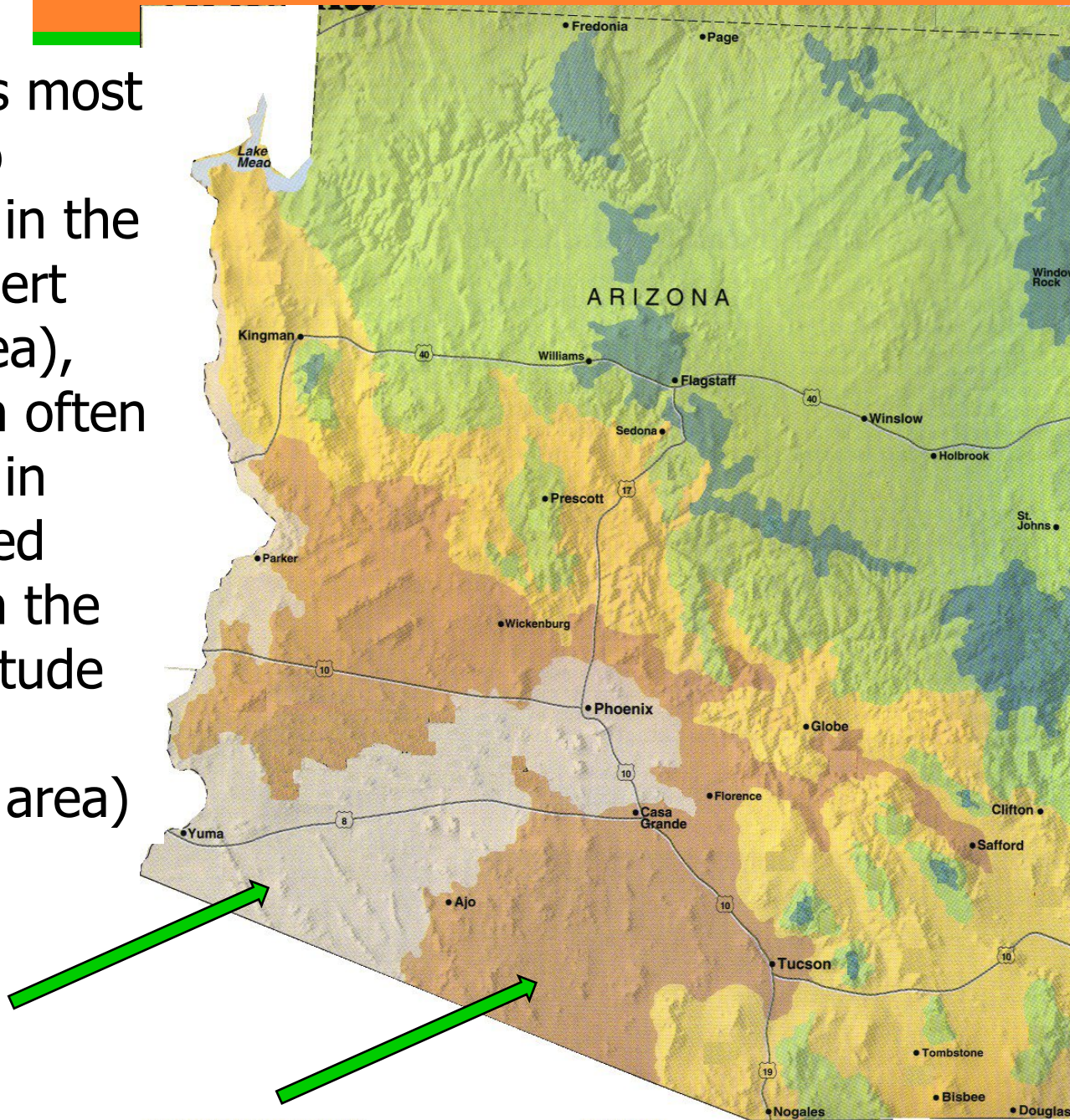


Table 1. Relative frost sensitivity of selected citrus trees

Common name	Scientific name	Sensitivity to frost*
TREES		
citron	<i>Citrus medica</i>	H
grapefruit	<i>Citrus × paradisi</i>	M
kumquat	<i>Fortunella</i> spp.	L
lemon	<i>Citrus limon</i>	H
lime	<i>Citrus aurantiifolia</i>	H
mandarin orange hybrids	<i>Citrus reticulata</i> ssp.	M
orange	<i>Citrus sinensis</i>	M
Satsuma mandarins	<i>Citrus reticulata</i> ssp.	L
ROOTSTOCKS		
rough lemon or Alemow	<i>Citrus macrophylla</i>	H
trifoliolate orange	<i>Poncirus trifoliata</i>	M
Troyer and Carrizo citrange	× <i>Citronicirus Webberi</i>	M

Note: * H = high sensitivity; M = moderate sensitivity; L = low sensitivity. Trees with a high sensitivity are more easily damaged by frost than trees with a low sensitivity. For information on frost sensitivity of particular cultivars in your area, consult reliable nursery staff or your local University of California Cooperative Extension county office.

More than 4 to 6 hours at 28 F or below will be damaging

Cold Protection for Citrus



- Plant in warm area.
 - Southern exposure
 - Cold air drainage
- Maintain weed free area around tree
- Irrigate before frost begins.
- Use wind machine.
- Smudge pots?

Spraying for pests

How will it be done?



Citrus Thrips Damage



Citrus Thrips Damage



No control needed.

Spider Mites



Typically, no control needed. Most any miticide will control this pest.

Citrus Peel Miner Damage



No control needed.

Citrus Leaf Miner

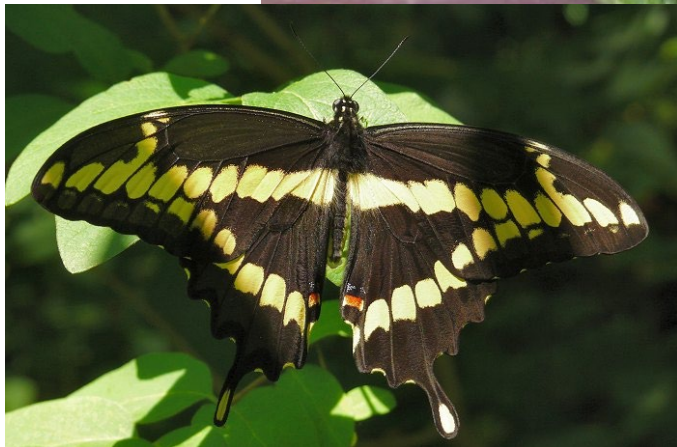




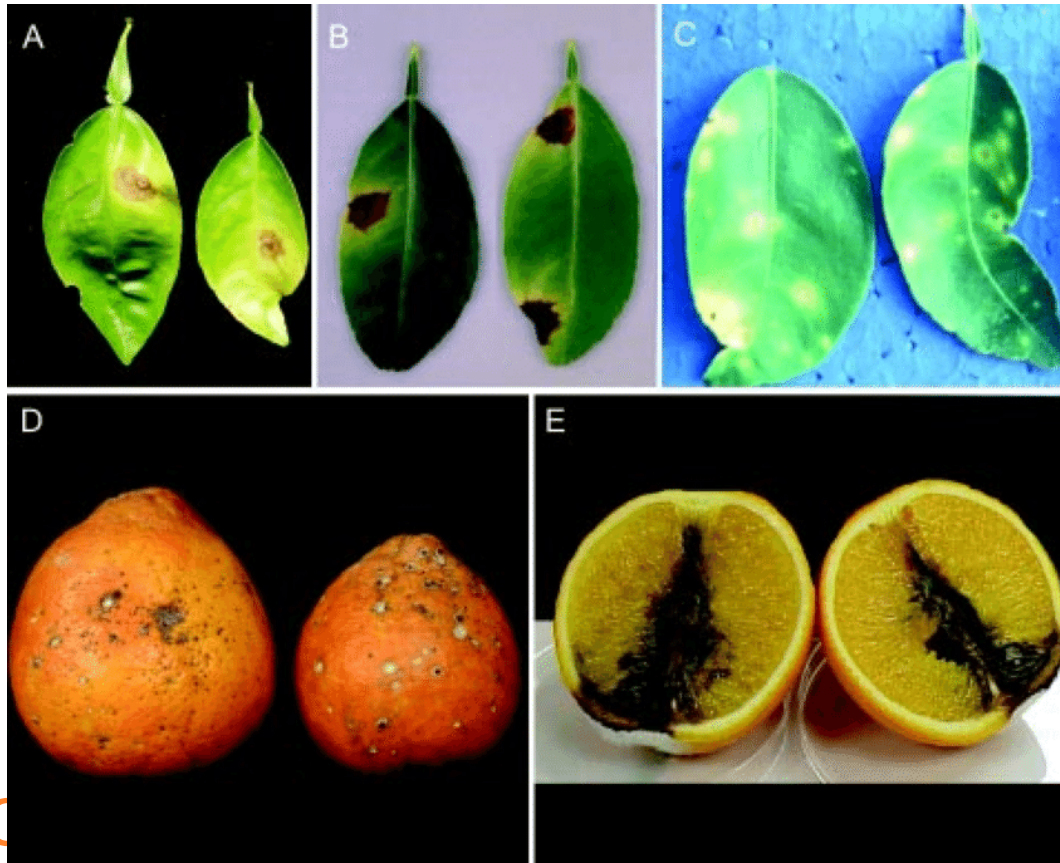
No control needed.

Orange Dogworm

Typically, no control needed.
May be treated with garden
insecticides that will control
caterpillars.



Alternaria (Black Rot)



Alternaria



Phytophthora (Foot Rot)

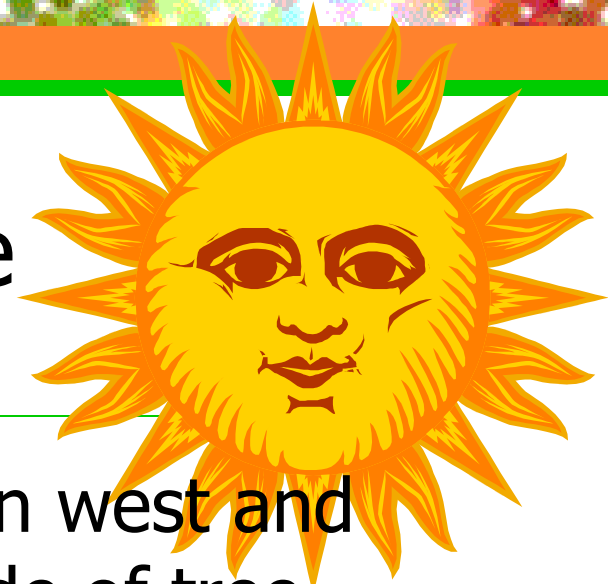


Control is expensive. Prevention is the best control.
Provide good drainage.

Mesophyll Collapse



Mesophyll Collapse



- Found on west and south side of tree.
- Due to sun exposure



Sunburn



Fruit Splitting



- Potential causes:
 - Low N status of tree
 - Uneven watering
 - Large crop load
 - Sunburn
 - Genetics (some varieties are prone to splitting)

Granulation – What to do?

- Pick fruit earlier.
- Pick small fruit, as it is less likely to be granulated.
- Don't over-fertilize with N. Too much N will cause granulation.
- Choose a non-vigorous rootstock.
- It is not an irrigation problem, so don't compensate by overwatering



Sheepnose

- Sheepnose occurs on young grapefruit subject to high temperatures during the cell division stage (Stage I).
- Excessive cell division in the albedo occurs.
- Don't over fertilize with N
- Will become less common as tree ages.



Gophers and Other Varmints



- Generally chew on the bark and cause girdling and occasionally tree death, or eat tree roots
- Also include rabbits, coyotes and deer.
- Woodpeckers can damage fruit

Woodpecker and Rat Damage

Woodpecker

Rat



Woodpecker and Rat Damage



- What will scare away birds?
 - Shiny things
 - Cats
 - Loud explosions
- What will keep out rats?
 - Cats
 - Traps
 - Eliminate fruit

