



Citrus Production Basics



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Brief History of Satsuma Production in AL

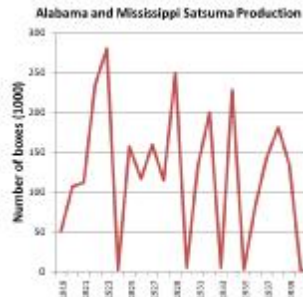
- In 1923, there were 12,000 bearing acres of satsumas in South Alabama. 6,000 acres non-bearing.
- Production in 1923 was 700 train carloads. Valued at \$1.25 million. Growers got \$1.50 for 3/4 bu. Box (~35 lbs).
 - At -.075\$ per lb would be ~\$21.9 million
- A freeze of 11 F on 1/7/24 destroyed the entire fruit crop for 1924.
- A freeze of 20 F on 11/20/40 destroyed the industry.

Alabama Citrus History



What happened?

- 1923 harvest – peak for AL (700 carloads)
- Jan. 6, 1924 – sudden temp. drop to 12F
- 1926 – severe storm early fall
- 1928 – freeze damage
- 1930 – severe freeze
- 1933 – severe freeze
- 1935 – 2 freeze events
- Gradual dying out of trees as a result of freeze injury (1930, 33, 35)
- Nov. 20, 1940 – sudden change in temp. from 80F to 20F. Also, very cold January.




TURN FROM COTTON TO ORANGE GROWING

Alabama Planters Find Fruit
from Japan Thrives on
Old Forest Tract.

NY TIMES April 18, 1915


Satsuma industry is on the rise again





SUCCESSION SHEET FRUIT—of which Northern A. holds great quantities and which are a favorite in part of the South. It is one of the best for the industry in Alabama.

Alabama satsumas going mainstream

A project for the AL horticulture department started in 2002 to revitalize Alabama's citrus industry by using Minnie Nozaki, an orchard owner at the Gulf Coast Research and Extension Center in Panama who's been involved in the project for 10 years.



Cold Hardiness of Satsumas and other Citrus

Trifoliolate Orange	**** superior
Kumquat	**** excellent
Changsha	****
Satsuma	**** excellent
Clementine	*** good
Navel Orange	** fair
Valencia Orange	**
Lemons & Limes	* poor

Hardiness a function of genotype, growth rate, and cold weather conditioning (acclimation).

World Fresh Citrus Market 2015-16 (1,000 metric tons)

Country	Total	Sweet Orange	Tangerine/Mandarin	Grapefruit	Lemon/Lime
China	31,300	7,000	20,000	4,300	-
Brazil	14,350	14,350	-	-	-
EU	10,467	6,055	3,035	97	1,260
US	7,829	5,371	876	735	847
Mexico	6,235	3,535	-	430	2,270

Interesting Statistics



Varieties and variety selection



US Citrus Market 2015-16 (1,000 metric tons)

Crop	Production	Consumption	Export	Import
Oranges	5,371	1,476	645	175
Tangerines	876	900	0	195
Grapefruit	735	301	123	13
Lemon/Lime	875	1,096	111	605



Mandarin

- q Loose-skinned
- q Deeply colored
- q Highly flavorful

- q Types
 - Mandarins
 - Satsumas
 - Tangerines
 - Hybrids



Sweet Oranges

- q Classic Orange
- q Comm. seedless
 - Hamlin
 - Ambersweet

- q Navel
- q Valencia - juice



Grapefruit

- q Named for its clustering fruit habits

- q Can be white, red, or pink

Satsuma

Early Ripening Early Oct.	Midseason (Late Oct.)	Standard Mid Nov
Armstrong Early	Brown's Select	Owari
Early St. Ann	Kimbrough	Silverhill
LA Early	Port Neches	Dobashi Beni
Okitsu Wase		
China S-9		

Sweet Orange

Washington (Navel)	Sept-Nov	Self-fruiting
Cara Cara (Navel)	Sept-Nov	Self-fruiting
Hamlin	Sept-Nov	Self-fruiting
Ambersweet	Sept-Nov	Self-fruiting

Satsuma



Grapefruit

Ruby (Redblush)	Early	Self-fruiting
Duncan	Oct-Dec	Self-fruiting
Triumph	Oct-Dec	Self-fruiting
Royal	Dec-Jan	Self-fruiting
Rio Red	Dec-Jan	Self-fruiting
Marsh	Feb-Jan	Self-fruiting

Tangerines and Hybrids

Clementine	Nov-Dec	Cross-Pollination
Ponkan	Nov-Jan	Self-fruiting
Dancy	Dec-Jan	Self-fruiting
Orlando	Oct-Dec	Cross-Pollination
Robinson	Very early	Cross-Pollination
Sunburst	Very early	Cross-Pollination
Lee	Sept-Nov	Self-fruiting
Osceola	Dec-Jan	Cross-Pollination

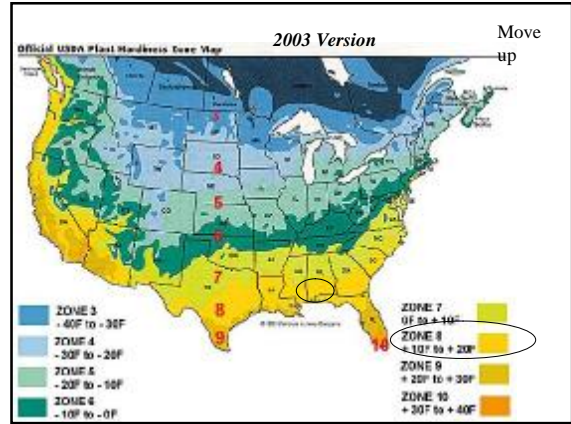
Lemon and Lime and Lime Hybrids

Meyer (lemon)	Sept-Nov	Self-fruiting
Key(lime)	Oct-Dec	Self-fruiting
Persian (lime)	Oct-Dec	Self-fruiting
Eustis (lime hyb)	All Year	Self-fruiting
Lakeland (lime hyb)	All Year	Self-fruiting
Tavares (lime hyb)	All Year	Self-fruiting

Citrus Germplasm



<http://www.citrusvariety.ucr.edu/citrus/>



Citrus Germplasm

r rootstocks



Fairchild mandarin (Clem x Orlando)



Nova (Clem x Orlando)



Fremont (Clem x Ponkan)



Cara Cara Navel Orange



Citrus trees are grown (by grafting) on rootstocks

- Common rootstocks
 - Trifoliolate Orange, Sour Orange, Rough Lemon, Swingle Citrumelo, Cleopatra Mandarin, etc.
- Size Control—Dwarfing (Flying Dragon)
- Nematode and Phytophthora resistance
- CTV Resistance
- Soil pH tolerance
- Cold tolerance (Trifoliolate Orange is best)

Satsuma (*Citrus unshiu*)



- Satsuma on Trifoliate Orange rootstock is one of the most cold hardy commercial citrus plants.
 - Tolerates temperatures as low as 12-14 F when acclimated, but can be damaged at 20-23 F when not acclimated.

Some Things to Remember

- q Plant varieties that can be harvested during the early season (September – November)
- q Mandarins are the most cold-hardy.
- q Satsuma Mandarin best suited
- q Grapefruit requires cold protection
- q If cross-pollination is required for a variety choose another variety that flowers at the same time.
- q Trifoliate Orange rootstock – ‘Flying Dragon’
- q High tunnel production opens the door.

Rootstocks



Site Selection and Plant Establishment

- q Full sun
- q Interplanted Satsuma
- q Well drained sandy loam soils
- q Plant spacing 10 ft -15 ft within-row; 20 ft between rows; smaller plants can be spaced 8 ft – 10 ft within-row
- q Dwarfing rootstock (‘Flying Dragon’) 10ft within rows in high tunnel
- q Early varieties on Flyin ragon can be spaced closure

Flying Dragon

Rubidoux



Site Selection and Plant Establishment

- q Container or ball and burlap
- q Purchase healthy 1-year-old trees 3/8 – 5/8 in. caliper measured 1 in. above graft union
- q 2-year-old trees 5/8 – 1 in. caliper
- q Ideal time to plant: Early spring
- q Individual tree planting sites: 4 ft – 5ft diameter with all grasses and weeds cleared
- q Soil tests should be performed the fall prior to the season of planting

Site Selection and Plant Establishment

- q Prepare a hole large enough for root ball.
- q Place root ball in the hole keeping root ball level with the ground surface.
- q Refill hole with half the required soil add water to settle the soil.
- q Finish back-filling the hole
- q Pack soil firmly against the trunk
- q Using the soil, create a water basin 30 – 36 in. diameter and 4 in. high

How much fertilizer?

Tree Age Years	Lbs N /Tree/Year	Lbs 8-8-8 /Tree/Year	Lbs 13-13-13 /Tree/year	Lbs 16-4-8 /Tree/year	Lbs 34-0-0 /Tree/year
Planting Year	0.05 oz.	10 oz.	6 oz.	5 oz	2.4 oz.
1-yr-old	0.2	2.5	1.5	1.25	0.6
2-yr-old	0.4	5	3	2.5	1.2
3-6-yr-old	0.75	9.4	5.8	4.7	2.2
7-8 yr-old	1	12.5	7.7	6.25	3
9-yr-old	1.5	18.75	11.5	9.4	4.4
10+ yr-old	1.5	18.75	11.5	9.4	4.4

Only one fertilizer source should be used at the rates indicated. If a combination of more than one fertilizer is desired in the same year, the rates of each should be reduced to meet the correct rates.

Site Selection and Plant Establishment

- q Water twice weekly 1 to 2 in. per week during first two weeks
- q Reduce watering to once per week
- q Water every 7 – 10 days once plants are established during the growing season
- q Keep area around plant free of grass and weeds.

When do I fertilize?

Fertilize 3 times per year:



Pruning

- q Citrus requires minimal pruning during the first year
- q Should remove shoots below the scaffold limbs
- q Scaffold branches should be 18 – 20 in. from the soil
- q At planting: Cut branches back to 6 – 12-in. stubs
- q No pruning is required to produce fruit
- q Pruning should occur in the spring and summer

Some Things to Remember

- q Proper spacing
- q Full sun
- q Well drained soils
- q Caliper is appropriate for plant age
- q Plant at proper depth
- q Water appropriately
- q Very little pruning is required
- q Fertilize at the appropriate times and at recommended amounts

What causes large, thick-skinned, rough fruit?

- Light Crop or High Leaf to Fruit Ratio
 - Common on young plants
- Freeze injury to Foliage
 - Heavy Fruit drop
- Inadequate Fertilizer in Heavy Crop Year resulting in Alternate Bearing
- Late blooming



Fall Irrigation

- Heavy rains or irrigation in fall may reduce solids (sugar) and total acidity in fruit, by dilution effect; increasing juice content.
- Excessive dry spell when fruit is ripe will cause reduction of peel turgor.
- Irrigate when available water falls below 33%.

Spring Irrigation

- Water stress during bloom/set period can reduce number of fruit per tree.
 - Increased abortion, especially young trees.
- Fruit size can be reduced by water stress during the early swell period.
- Irrigate when soil moisture drops below 66% of available water

Internal quality

- Brix=soluble solids=Sugar
 - Measured by light refractometer
- Titratable acidity=% Citric Acid
 - Measured by acid titration procedure



Brix: Acid Ratio (10:1 desired)

8.7 Brix: 0.87% Acid=10:1

6.8 Brix: 0.68% Acid=10:1

Not the same tasting fruit!!!

Summer Irrigation

- Irrigate when available water is below 66%
- 3/4 acre inch water per week=200 gallons per tree per week or 28 gallons per day.
- A 12 gph microjet operated twice per week would be run 8 hours each time.
 - Three times per week, 5 hours per run would be better.

Factors that increase tree health and canopy sunlight reception increase accumulation of soluble solids!



10/1: 8.4

11/1: 8.7

12/1: 9.3

Production in Containers



Container Culture

Varieties Recommended for Container Production

Owari	Satsuma mandarin
Brown's Select	Satsuma mandarin
Kimbrough	Satsuma mandarin
Nagambi	Kumquat
Meyer	Kumquat

Container Culture

- q In-ground citrus production is suited for the coastal region of Alabama
- q Cold is limiting factor
- q Container production is necessary for citrus in more northerly counties of Alabama
- q Many citrus plants can withstand 18-20 ° F
 - q Leaf temps can fall 4 ° below ambient
- q Citrus fruit freezes at ~26 ° F.

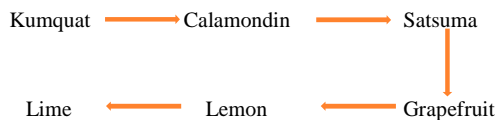
Container Culture

- q Citrus trees are usually sold in 2-3 gallon containers
- q Re-pot after first year
- q Re-pot every 3-5 years thereafter
- q 15 gallon nursery container



Container Culture

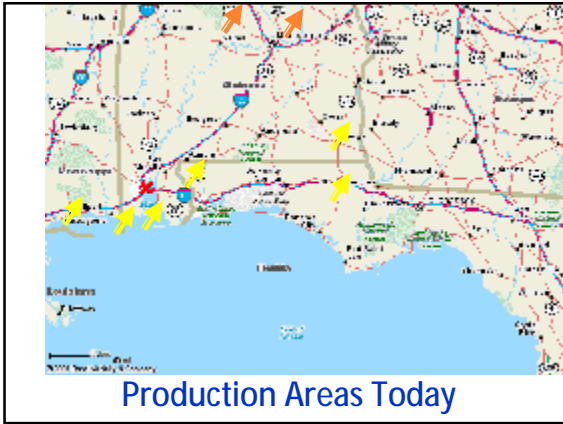
From Greater to Lesser Cold Tolerance



Container Culture

- q Pots should allow good drainage
- q Cut holes in the sides of the pot near the bottom
- q Do not use garden soil
- q 4:1 mixture of pinebark and sand.
- q Proper planting depth





Container Culture

Diseases

- q Root rot
- q Sooty mold fungus



Container Culture

Watering and Fertilizing

- q Requires more frequent watering than soil cultivated citrus
- q Frequent watering leaches nutrient
- q Use a slow-release fertilizer
- q Micronutrients



Alexander City, AL



Container Culture

Insect Challenges

- q Spider Mites
- q Citrus Rust Mites
- q Scale
- q Aphids
- q Citrus Leaf Minor



Some Things to Remember

- q Large Container
- q Well drained media
 - q 4:1 pine bark to sand
- q Stable Moisture
- q Slow-Release Fertilizer (with minors)
- q Pest Control
 - q Mealybugs, mites, whitefly,



Pest Issues



Citrus Red Spider Mite



What pests should you be concerned about?

- Rust Mites
- Red Spider Mites
- Birds (mockingbirds, thrushes, blackbirds)
- Melanose Disease
- Leaf-footed Bugs & Stinkbugs
- Scale
- Whiteflies
- Citrus Leafminers
- Citrus Scab



Leaf-footed Bug



Rust Mite

Citrus Whitefly



Ultra Fine Oil: (Paraffinic oil)

Use when temp. <90 °F and plants are well watered.

Citrus Leafminer



Giant Swallowtail (OrangeDog)




Bird Damage



Invasive Diseases


- CTV (Citrus Tristeza Virus)
- Citrus Canker
- Citrus Greening Disease




Citrus Greening: Serious threat to Alabama citrus

Symptoms

- q Vein yellowing
- q Blotchy Mottle
- q Leaves small and upright
- q Poorly developed root system
- q Fail to color properly
- q Salty and bitter taste
- q Productivity decline



Citrus Greening: Serious threat to Alabama citrus

Citrus Greening: Serious threat to Alabama citrus

- q AKA: Huanglongbing
- q Discovered in FL in 1998



<http://nationalcleanplantnetwork.org/Citrus/>



The End
Questions ?