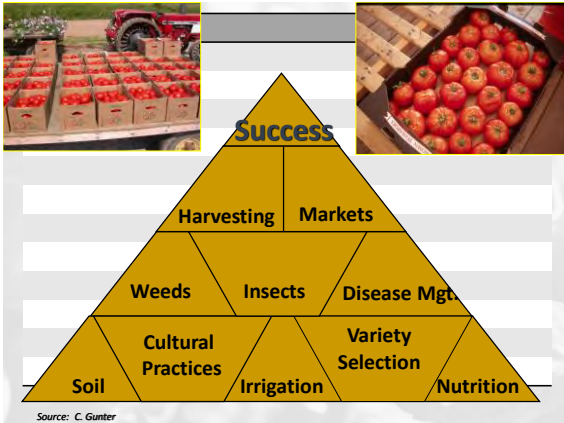


Greenhouse and High Tunnel
Work Shop

Tomato Production



Adapted from a
'Missouri Grown' presentation



I. SELECTION OF VARIETIES

- One of the most important management decisions
- A number of characteristics are important to consider when selecting varieties
 - Fruit Color
 - Fruit Size
 - Disease resistance
 - Vine type



Fruit Size



Extra-Large (beef steak)



Large (slicing)



Medium/Small (processing)



Cherry (salad)



Currant

*As fruit size decreases labor increases

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Disease Resistance

- Look for these letters after the name of the cultivar

Letter	Cultivar Resistant to:
V	Verticillium wilt
F _{1, 2 or 3}	Fusarium wilt (races)
N	Root knot nematode
T	Tobacco mosaic virus
A	Alternaria (early blight)
ST	Stemphylium (gray leaf spot)

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Vine Types

- Determinant
 - o Produces a flower cluster at the terminal growth point
 - o Stops growth at a certain height
 - o Fruit matures over shorter time
 - o Some cultivars can be grown in containers

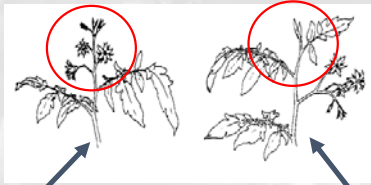


Vine Types

- Indeterminant
 - Never set a terminal flower cluster
 - Continue to grow taller
 - Older cultivars
 - Continue to bear until frost



Growing Terminal Comparison



Determinant

Indeterminant

Vine Types

- Semi-determinate
 - Newest classification
 - Ends with flower cluster but grows taller
 - Best of both previous types
 - Adaptive to "short stake" trellising



Indeterminate Example: Big Beef

- Red fruit; hybrid
- Large, beefy fruit with excellent flavor
- Resists fruit cracking
- Fruit can be allowed to vine ripen and still remain firm
- Excellent disease resistance package (VFNT)



Semi-determinate Example: Mountain Fresh +

- Red-fruited hybrid
- Produces large fruit with excellent quality
- Resists fruit cracking
- Very popular variety for short-stake trellising
- Good disease resistance



Heirloom Example: Brandywine

- Indeterminate vine—pink/purple fruit
- Heirloom type— very large, irregular fruit susceptible to cracking
- Considered by many to have better flavor than hybrid varieties
- Lower yields than hybrids
- Lacks disease resistance



II. Cultural Practices

- Required growing conditions
 - Need at least 6 -8 hours of sunlight per day
 - Prefer good "garden loam"
 - Require warm temperatures for growth (time planting accordingly)
 - Water, nutrition and pest control very important



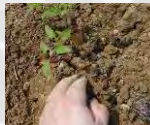
Planting Layout & Spacing

- Planting rate: 2600-5800 plants/acre
- Single rows or double rows (compact cultivars)
- Spacing:

Spacing	Beds	Variety size	
		Small vined (Determinant)	Large vined (Indeterminant)
Between row or bed	5-6'	4'-6'	5'-7'
Within rows, between plants	18"-30"	12"-24"	2'-3'

Planting Tomatoes

- Started as transplants
 - 6 weeks from seeding to field
- Space according to trellis system and cultivar
 - 20-24 inch between plants common
- "Water in" with soluble fertilizer high in phosphorous
 - E.g. 9-45-15
- Trench plant leggy plants



Mulching

• Tomatoes often grown on black plastic mulch

o Advantages

- Suppresses weeds
- Maintains more even moisture
- Keeps the fruit cleaner
- Improves earliness

o Disadvantages

- Shallow rooting



Pruning and Plant Support

■ Advantages

- Promotes early, larger and cleaner fruits
- Easier to harvest
- May help reduce disease problems

■ Disadvantages

- Lower yields
- Increase risk of sunscald and fruit cracking



Tomato Pruning

• Pruning or “suckering”

o Suckers are small lateral shoots in leaf axils or crotch of small branches

o Pinch off when less than an inch long so plant puts more energy into fruit

o Most often done to staked, indeterminate tomatoes



Pruning

- Pruning or “suckering”
 - Suckers: small lateral shoots in leaf axils
 - Pinch off when less than an inch long
 - Most often done to staked, indeterminate tomatoes
- Leaf pruning is also practiced



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Trellising

- Individual stakes



Fastened to stake with twine

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Trellising

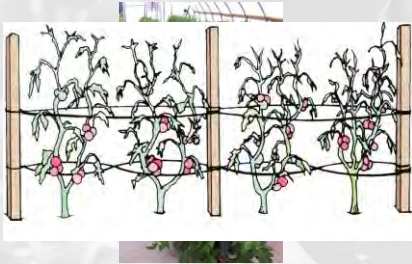
- European trellising method



Overhead wire with twine support

Trellising

- Stake and weave system



Trellising

- Cage system

- Little or no pruning
- Produce more fruit
- Later Ripening
- Low sunscald



Irrigation (fertigation)

- Water stress induces blossom-end rot
- Plants require 2 – 2.5 qts. water/day as fruit sizes
- Equals 1000 gal./week for high tunnel with 300 plants
- Drip irrigation preferred method of application

Drip Irrigation

- Widely used
- Place UNDER plastic mulch
- Schedule irrigation
- Design system to allow for nutrient injections



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Tomato Nutrition



- Test soil annually
- Some of the nitrogen and most of the phosphorus and potassium required by a crop can be applied as pre-plant—amount depends on soil test
- DO NOT apply too much nitrogen early in crop (promotes vegetative growth)

Pre-plant Fertilizer Application

- 30 lbs. nitrogen/acre
 - 0-240 lbs. P_2O_5 /acre*
 - 0-300 lbs. K_2O /acre*
- } banded application

* = based on soil test results

Tomato Nutrition, cont.

- Once fruits have set, apply additional nitrogen
 - First fruit about golf ball size
 - Calcium nitrate + 4-18-38
 - Alternate with potassium nitrate + 4-18-38
 - Potassium linked to fruit quality



Deficiency symptoms--



Deficiency symptoms--

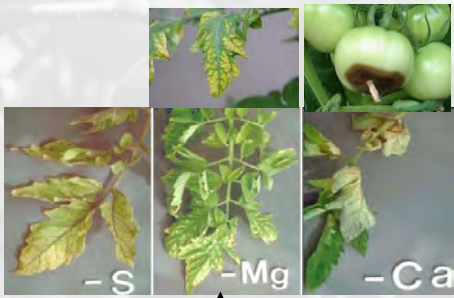


Deficiency symptoms--



lower (older) leaves

Deficiency symptoms--



lower (older) leaves

Deficiency symptoms--



upper (younger) leaf

Mulching

- Weed control
- Moisture retention
- Plastic or organic



III. Tomato Problems



Blossom-end rot

- A dry, leathery brown rot of the blossom end of the fruit
- Caused by poor calcium distribution in the fruit
- Solutions
 - Select cultivars that are less susceptible
 - Maintain even watering



Fruit cracking

- Caused by irregular water supply
 - Sudden abundant moisture, especially following drought
 - Heirloom varieties especially susceptible



Radial



Concentric

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Yellow Shoulder

- Linked to heat stress
- Potassium nutrition also implicated
- More severe on "green shoulder" varieties
- Maintain adequate foliage cover and potassium fertility



Green (White) Core

- Heat stress
- Potassium deficiency



Sun Scald

- Bleached area on fruit
- Caused by direct exposure to sun/heat
- Prevent by maintaining good foliage cover



Catfacing

- Malformed fruit that appear scarred
- Most often seen on first clusters
- Associated with low temperatures at fruit set



Pest Management: Disease Origin



FUNGAL



BACTERIAL



VIRAL

Tomato Diseases—*Alternaria*

- Also called early blight
- Fungal disease—spores survive on plant debris
- Use IPM control
 - Planting rotation
 - Strict sanitation
 - Keep foliage dry
 - Fungicides for total control



Fusarium and Verticillium Wilts

- Soil borne; survives in soil for years
- Plants generally affected through roots
- Rotation (at least 2-3 years)
- Plant resistant varieties



Septoria Early Blight

- Survives over winter on infected plant debris
- Spores disperse by splashing water
- Favored by warm, moist conditions
- Symptoms generally appear first on lower leaves
- Follow *Alternaria* control measures



Fruit anthracose

- Favored by warm, wet conditions
- Survives in soil and plant debris
- Spores splashed by rain or irrigation onto foliage and fruit
- Ripe or overripe fruit most susceptible--progresses rapidly
- Stake and mulch plants
- Remove and destroy infected fruit
- Fungicide sprays



Bacterial spot/speck



Spot

Speck

Pest Management: Insects



Diseases--Viruses

- Light and dark green mottled leaves
- Necrosis of fruit with some strains
- Stunting, abnormal growth of plants depending on growth stage
- Virus easily transmitted by workers, machinery, insect vectors
- Virus survives on equipment, in plant debris—tobacco products
- Workers should wash hands and sanitize equipment before handling
- Use resistant cultivars



Cucumber mosaic virus



Double streak virus



Walnut Wilt

- Response of tomato to juglone—compound produced by roots of walnut trees
- Do not plant tomatoes within 50 feet of walnut trees



Herbicide Injury

- Tomatoes are very sensitive to herbicides in general
- 2,4-D and herbicides with similar action especially damaging to tomato



Disease: Management

- Spray plan
 - Field, weather, disease specific
 - Rapid resistance development
 - Midwest Vegetable Production Guide for Commercial Growers
 - See your local extension agent



IV. Harvesting Tomatoes



V. Economics: Profitability

Missouri Tomato Cost-Return Budget, Trickle Irrigation, Fresh Market

	Yield Level (20 lbs. per box)		
	1,100 boxes	1,300 boxes	1,500 boxes
Income	\$12,650	\$14,950	\$17,250
Variable Costs	\$9,652	\$10,322	\$10,992
Fixed Costs	\$508	\$508	\$508
Total Costs	\$10,160	\$10,830	\$11,499
Return over Total Costs	\$2,490	\$4,120	\$5,751
<hr/>			
Total costs/box	\$9.24	\$8.33	\$7.67
Return/box	\$2.26	\$3.17	\$3.83

Assumes \$11.50 selling price per box or \$0.58 per pound (wholesale)
 No marketing or delivery costs were included in this estimation.

University of Missouri (2013)

Questions?



<http://i.imgur.com/VZgAU0K.gif>
