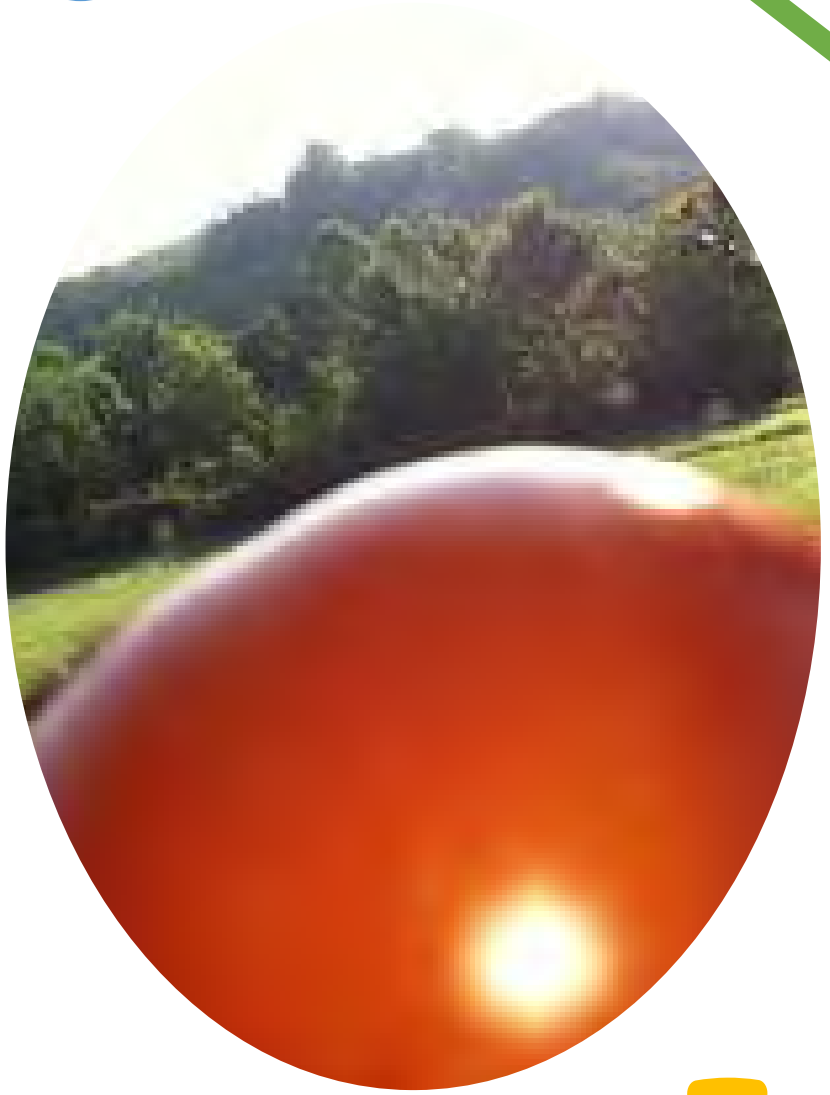


Growing Great Tomatoes

Susan Fox, Lyon County Extension Agent

for Agriculture and Natural Resources

The Story of the Tomato (Tuh-May-Toh, Tuh-Mat-To)

A berry, it is a fruit that is used as a vegetable…

Poll: Where did tomatoes originate?

1. Italy
2. Spain
3. South America
4. United States
5. Mexico

Origins

- Ecuador through South America. Weeds (cherry type tomato) took it to Mexico.
- Indians of Mexico called it *tomati or tomatl.*
- Colonization of Americas - Europeans took tomatoes to Europe and Asia in 16 and 17th centuries. Probably yellow.
- Pizza, Spaghetti, Lasagna developed, salsa probably came first?
- Grown in the US around 1780's, New Orleans recipes 1812

A Poisonous Perception

- Robert Gibbon Johnson, Salem, NJ in 1820 publicized that he would eat a basket of tomatoes grown in his garden.
- Hundreds traveled to watch, Johnson survived
- (Thomas Jefferson, Italian immigrants and others were also eating tomatoes.)
- Taste for tomatoes appears to be acquired and took time to develop. Many Americans were repulsed by tomatoes.
- Tomato seeds sold in 1800's, 24 varieties listed in a garden book in 1863.
- AKA wolf peach, love apple, Jerusalem apple
- Leaves ARE toxic!

Solanum lycopersicum Shady Family

- Solanaceae family aka the Nightshades
- Some of this family are toxic
- Tomatoes are now considered the most important horticulture crop globally
- Includes peppers, potatoes, tomatillos, eggplant, petunia, tobacco
- You can graft a tomato and a tobacco plant (tomato will have some nicotine) or tomato and potato plant….(Pomato!)

Good for You

- Rich in Vitamins A & C
- Good source of potassium
- Low in calories
- Lycopene protects cells from oxygen damage

The Perfect Tomato

- Type (determinate, indeterminate)
- Plant Size (dwarf or patio)
- Fruit size (eat all at once, big for hamburger, snacking)
- Usage/fruit size – fresh, slicing, sauce
- Color – red, pink, yellow, purple, green
- Flavor complex, sweetness
- Hybrid vs Heirloom
- Seed cavity, moisture content
- Disease, nematode, heat resistance
- Shipping qualities

Umami – Japanese for savory

- People have specific taste receptors for this flavor
- Foods with strong umami flavor include meats, shellfish, fish, soy sauce, tomatoes, mushrooms, yeast, cheeses, green tea, celery, spinach, ketchup!.
- Naturally occurring glutamates and Inosine and guanosine monophosphates.

- Tomatoes have complex flavors
- Acids and sugars
- 25 different volatile chemicals or aroma compounds that contribute to tomato flavor
- 13 of these are reduced in modern tomatoes
- Larger tomatoes have less sugar and flavor chemicals

10,000 Varieties!

- San Marzano
- Bradley
- Black Krin
- Black Opal
- Celebrity, Park's Whopper – great disease package
- Outhouse Cherry Tomato

?

What is your favorite tomato variety.

The Cheater Tomato

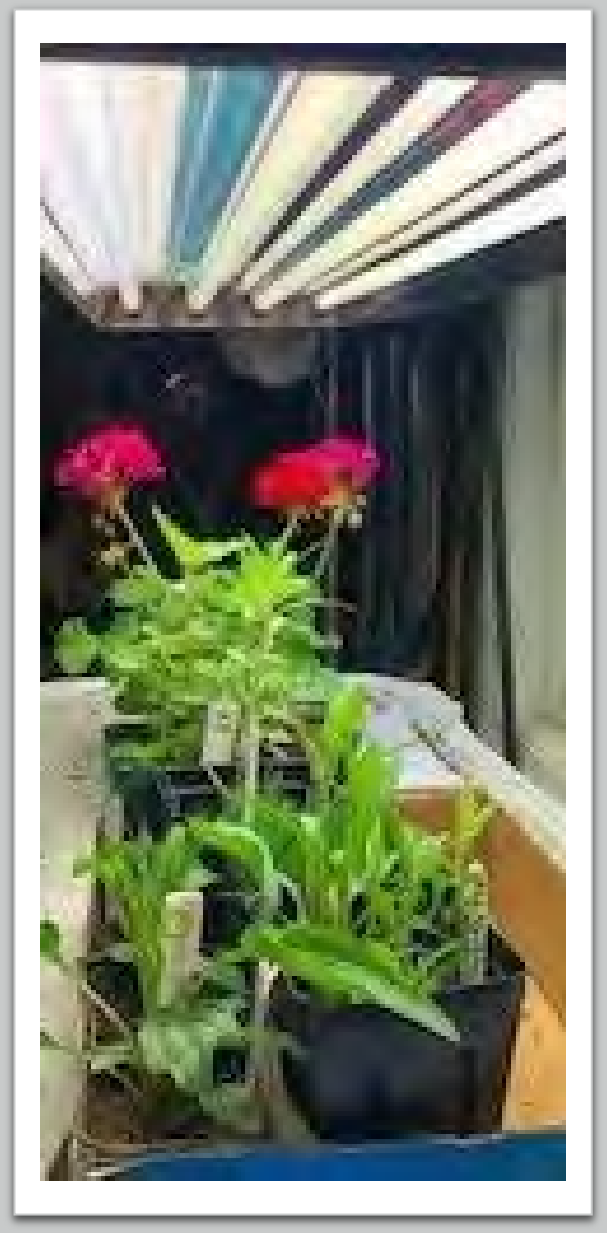
- Bragging rights for first tomatoes!
- Purchased flowering/fruiting
- Started early indoors
- Planted early outside use water rings to protect against cold.
- Best nighttime 59-68 degrees
- Largest tomato 7 lb, 12 oz,
- Disney tomato ‘tree’, Chinese variety, lived 13 months, and produced 32,000 golf-ball sized tomatoes (Wikipedia)

Starting Seeds

- Plants grown in larger cell trays (72 cells/tray) fruit earlier, 2” deep & wide
- Plants raised in smaller cells catch up
- Start seeds 5-8 weeks before transplant date
- Use sterile potting or seed starting mix
- Pre-moisten soil, plant ¼ inch deep
- Cover with dome lid
- Label varieties, very easy to forget, mix-up!
- Write down planting date, varieties in journal
- Seeds germinate best 75 - 85 degrees, in dark
- Mist to water as needed or bottom water
- Watch closely, move to light at germination
- 1-2 weeks to germinate
- High germination seeds - 2-3 cells with 2 seeds

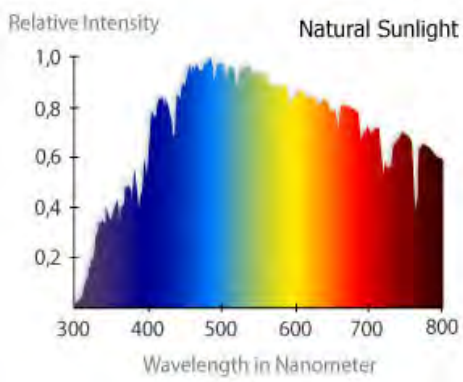
Growing Transplants

- Lighting ~4 inches above the plants, metal halide bulbs are hotter, 10-12”
- Florescent/LED lights - mix of cool and warm for broader spectrum, LED cooler bulbs, save energy.
- Lights on 14-16 hours, Ex: 6:00 a.m. - 10:00 p.m., timers help
- Grow at cooler temperatures, 65-75^{o}
- Fertilize at first true leaf, half-strength liquid fertilizer, every 2 weeks
- Do not overwater, damping off will kill seedlings
- Brush plants lightly to make stems stronger
- Harden off: shade first, couple of hours, increase gradually ~ 2 weeks, plant.



Lighting – Spectrum

- Use a mix of warm and cool light bulbs for improved spectrum
- 4-6 inches above the plants, higher if bulbs are hot
- NASA research shows that plants use mostly red and blue wavelengths
  - Red for stem and leaf growth, regulate flowering, dormancy, seed germination
  - Blue for chlorophyll content, leaf thickness, can stunt plants
  - 5:1 red to blue ratio
  - Also use green and far-red light to penetrate to lower leaves
  - Far red light increases leaf size, reduces the time to flowering
  - Different mixes are used at different stages of growth in indoor systems
  - White LED bulbs are more expensive, less light
  - **Plants need a lot of red and blue light, small amounts of green and yellow. Icing on the cake would be some Near IR and Near UV!**
  - **Intensity is important**



Light Spectrum

- Lumens measures what human eyes see. We see yellow and green better than red and blue. We don't see blue and red brightness very well so lumens is not very helpful for plants.
- **PAR** Photosythetically Active Radiation is a better measurement for light that is usable by plants
- **PPFD** Photosythetic Photon Flux Density measures the quantity of LED grow lights
- LED grow lights may see label changes that use PAR and PPFD
- Can't match direct sunlight 30,000 - 98, 000 lux (lumens per square meter) on a perpendicular surface at sea level.
- 100 watt incandescent = 20 watt LED = 1600 lumens

Tomatoes are a Tropical Plant

- **65-85 degrees – Optimum**
- 55 degrees – Misshapen, catfaced fruit may result
- 50 degrees – Poor fruit set, flower blossom drop, pollen development is incomplete
- 95 degrees – reduced fruit set, orange coloring

- Temperatures below 60 for extended periods can cause plants to flower profusely, flowers may remain open for several weeks without fruits forming.

Heirloom vs Hybrid

Heirloom tomatoes are open-pollinated

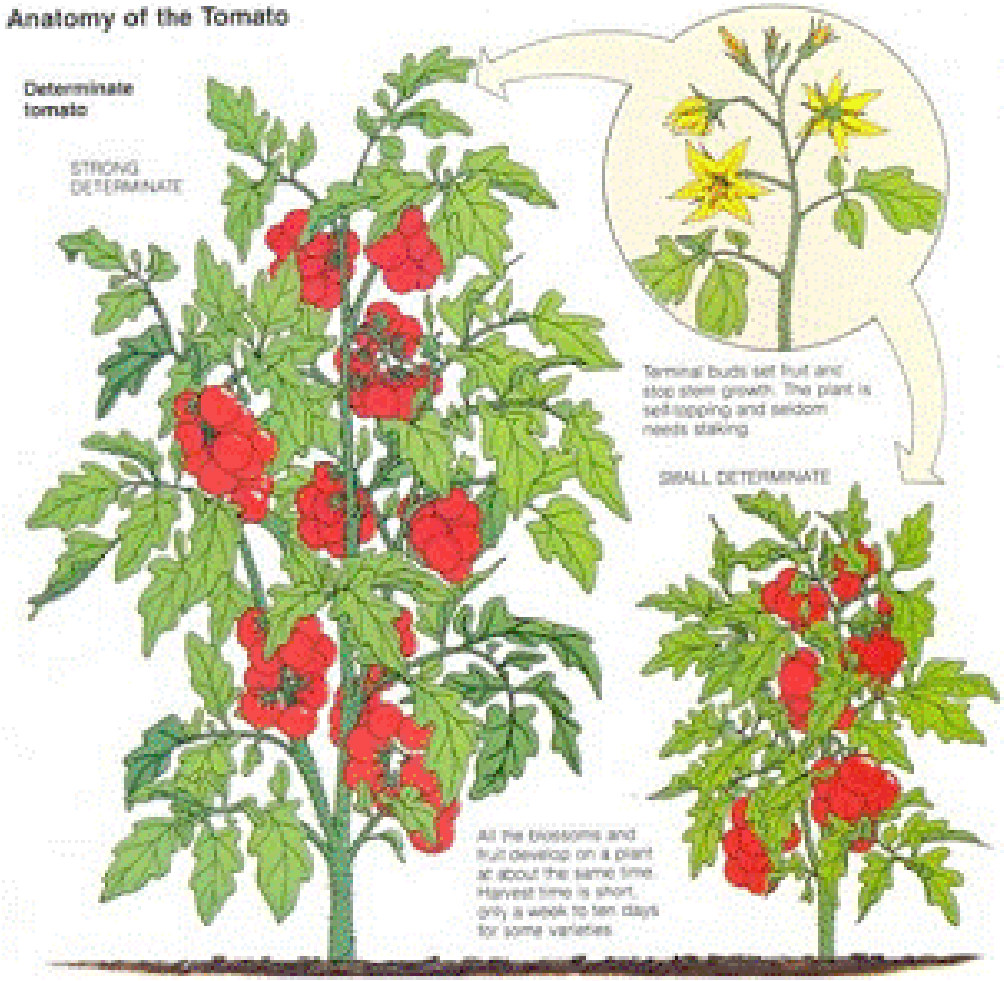
- 50 years old: Ex: Cherokee Purple, Brandywine
- Seeds will be true to the variety if isolated
- Self or insect pollinated, distance of 5-15’ from other tomato plants to prevent cross pollination

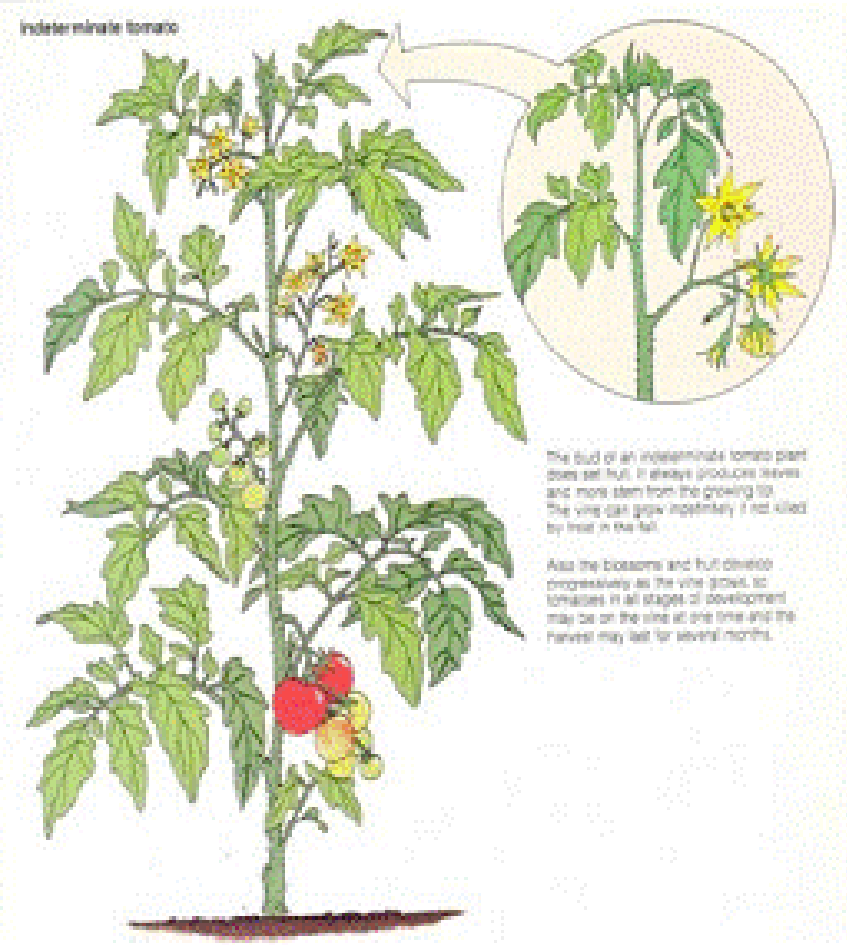
Hybrid tomatoes are cross-pollinated between two pure parent lines

- They are propagated by cuttings, F1 crosses
  - Have hybrid vigor, Ex: Celebrity, Big Boy
  - Plants grown from saved seeds will have unpredictable characteristics
  - Generally self-pollinated

Seed Savers Guide:
https://www.seedsavers.org/site/pdf/Seed%20Saving%20Guide_2017.pdf

Tomato Growth Habits
Determinate vs Indeterminate





Indeterminate Tomatoes

- Weak vines, tender perennials – supported with a trellis, cage
- Produce until killed by cold
- Pruning some suckers keeps manageable, improves air circulation, spray coverage
- Flowers continuously up the vine
- Flowers at the top, ripe fruit lowest
- Remove spent leaves at the bottom
- Leaves above feed the fruit below
- Vines can grow 30-40 feet long in 10 months in a greenhouse

Indeterminate Tomatoes

- Space 3-4’ apart in the garden
- Trellis with 3-6” posts at ends of row, 3-4” posts every 12-20’. Stretch 12-9 gauge wire over the top, a tensioner can be used to tighten the wire. Needs to be pruned to 1-2 vines only to trellis
- Attach twine (baler works well) to wire and tie loosely to bottom of plant. Wind the plant around the twine as it grows or attach to the twine with tomato clips.

Determinate Tomatoes

- Will set all fruit in 4-6 weeks
- Bushes growing to 3-4’ tall
- Fewer cultivars
- Good for containers
- Pinch suckers up to the first set of blooms
- Improves airflow, tomatoes off the ground
- Pots, containgers, stake, use tomato weave method, cages or tomato ladders

Semi-Determinate

- Some are container, bush types
- Many beefsteak cultivars
- Grow 3-8’ tall
- Space 18” to 2’ apart
- Stake, tomato weave, trellis, cages
- Pruning results in larger fruit and earlier ripening
- Carolina Gold, Celebrity, BHN 589

Heavy duty cage, folds up for storage, stake to hold up in storms. Small cages good for determinates.

Paste Tomatoes

- Meaty tomatoes with few seeds
- Higher soluble solids, and viscosity, less juice
- Intense flavor when cooked down, great sauce
- Cooks down faster
  - San Marzano – heirloom, indeterminate
  - Amish Paste - heirloom
  - Roma – compact, determinate
  - Margherita - determinate
  - SuperSauce - indeterminate
  - MiRoma – determinate
  - Yaqui – 10 -24” tall

Dwarf Tomato Project

- Began 2005, may have ended
- Volunteer tomato breeding project on multiple continents – US, Canada, Australia, New Zealand, Tasmania
- Developed by 100 volunteers, Tomatoville chat website
- Trying to put the large selection available in indeterminates into a plant size suitable for containers
- Plants are stout, foliage tends to dark bluish green and puckered, wrinkled or ‘rugose’
- Most are indeterminate
- Yield is less because they are smaller plants
- Give varieties to seed companies, all 125 releases can be found at the Victory Seed Company website.

HEIRLOOM AND RARE

DWARF TOMATOES

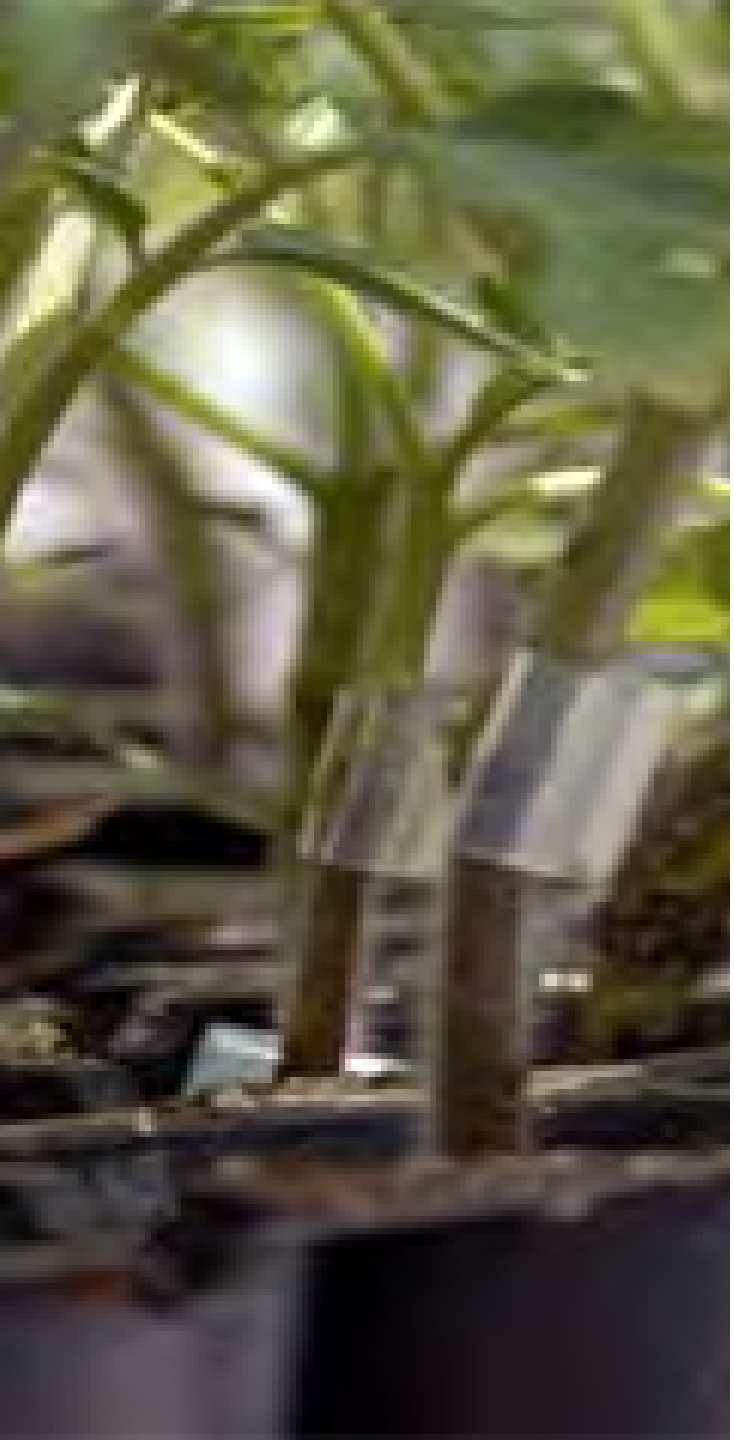
FOR CONTAINER GROWING AND GARDENING IN SMALL SPACES.

Cherry & GrapeTomatoes

- Cherry tomatoes have more juice, round shape, sweeter and more flavor complexity, best for stuffing for hors d'oeuvres. Prolific producers.
- Grape tomatoes are meatier, thicker skin, oblong shape, interchangeable with cherry tomatoes for salads, grilling, kabobs, snacking, etc.

Tomato Purchases

- Stocky, dark green plants
- Disease free
  - Late blight
  - Bacterial spot
- 6-8 inches tall for planting in garden



Grafted Tomatoes

- Typically, larger fruit and yields
- Resistance to soil born diseases, root nematodes
- Can yield as much as 3x more than ungrafted of same cultivar
- Helps with heirlooms and cultivars with poor soil pathogen resistance
- Cannot plant graft below the ground or the scion (top graft) will root
- Cannot let suckers below the graft grow

Site and Planting Basics

- Low nitrogen high phosphorus, medium potassium
- 8 hours of sun
- Raised beds where soil is wet natured, fragipan
- Good airflow: 2-4 feet apart
- Mulch to stabilize moisture, reduce weeds (straw, cardboard covered with mulch, newspaper, landscape fabric, white plastic with drip tape.
- Water easily available
- Pest control, fencing possible

Tomato Fertilization

- Soil test
- Amend garden before planting – adequate calcium, phosphorus, potassium, some nitrogen
- Additional fertilizer:
  - Nitrogen – 1 Tablespoon of ammonium nitrate every other week after fruit are a quarter in size
  - Too much N causes ‘bullish’ growth
- Organic use compost, bloodmeal, seaweed, fish emulsion, etc.

Optimum Soil Conditions: Soil, Air and Water

- Top right: tomato plants in kettle.
- Lower right: Same plants, from same 6-pack, with picture taken the same day. Planted in coconut coir/aged pine bark mix, 3-gallon pots with drip irrigation that runs for 10-15 minutes 8-10 times a day.

Planting Deep

- Deep planting can moderate root temperature, up to cotyledons or first set of true leaves
- Can reduce lodging on leggy plants, can trench sideways
- Planting to cotyledon increased yield 5#/50 sq ft in Florida (cooling effect)
- Flower earlier, significantly higher yields early on
- Yield advantage decreases with successive harvests.
- Don’t plant grafted tomatoes deep

Containers

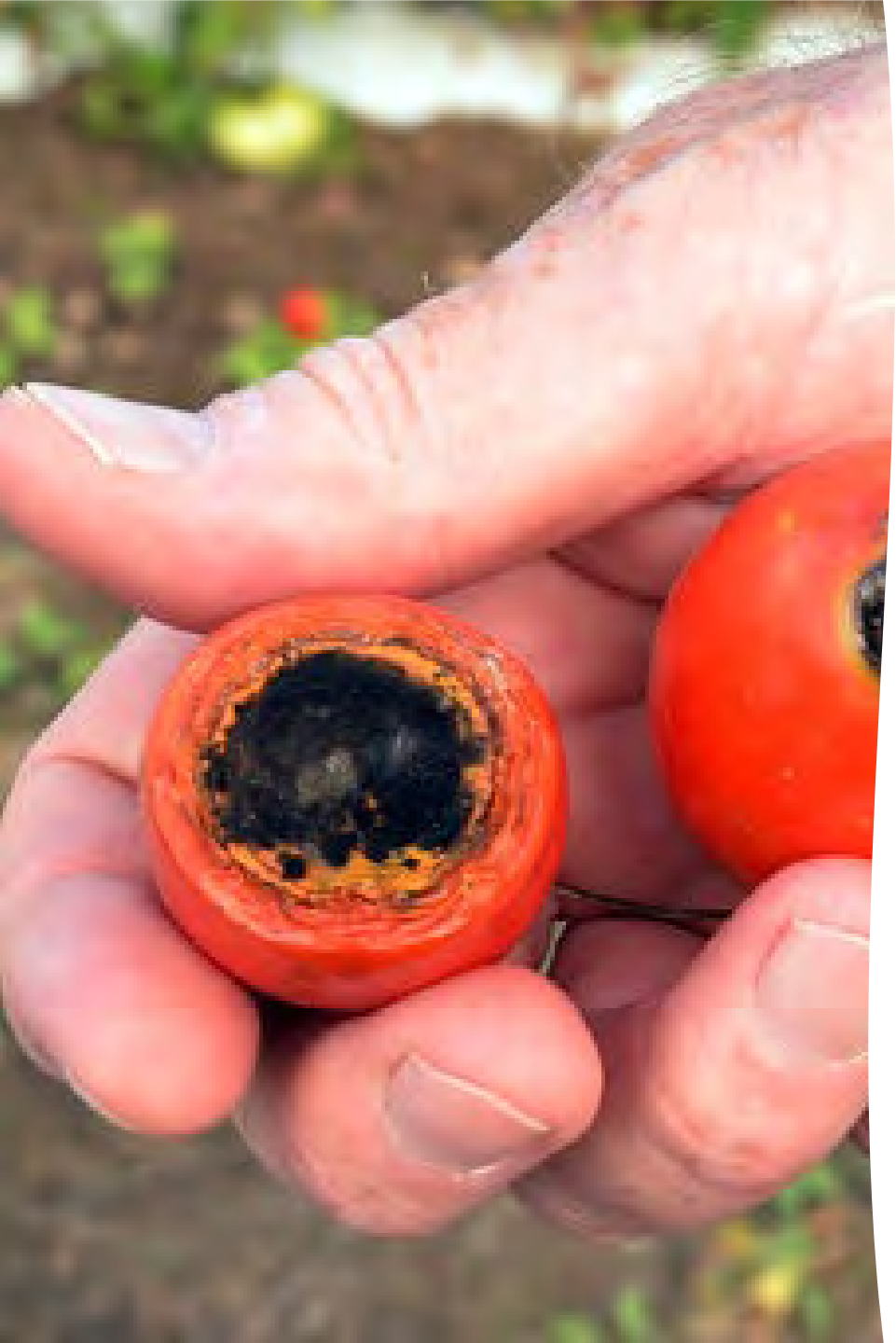
- If you're growing **tomatoes** in **pots**, ideally the final **container size** should be
- 10 gallons (for determinate types)
- 20 gallons (for indeterminate types)

Blossom End Rot Contributing Factors

For some time scientists thought that the problem is one of moving calcium around inside the plant, not necessarily a shortage. Various 'transporter' compounds, such as gibberellins and a recently isolated protein are responsible for moving calcium to points in the plant where it is needed. Calcium is required for cell growth and so it is required in fairly large amounts by the developing fruit. When these transporter compounds are not doing their job properly, it results in low levels of calcium at specific points in the plant.

The latest research shows that BER develops in the fruit first and only after it is a problem, do calcium levels in the fruit change.

What this means is that BER causes a calcium deficiency in the fruit, not the other way around.



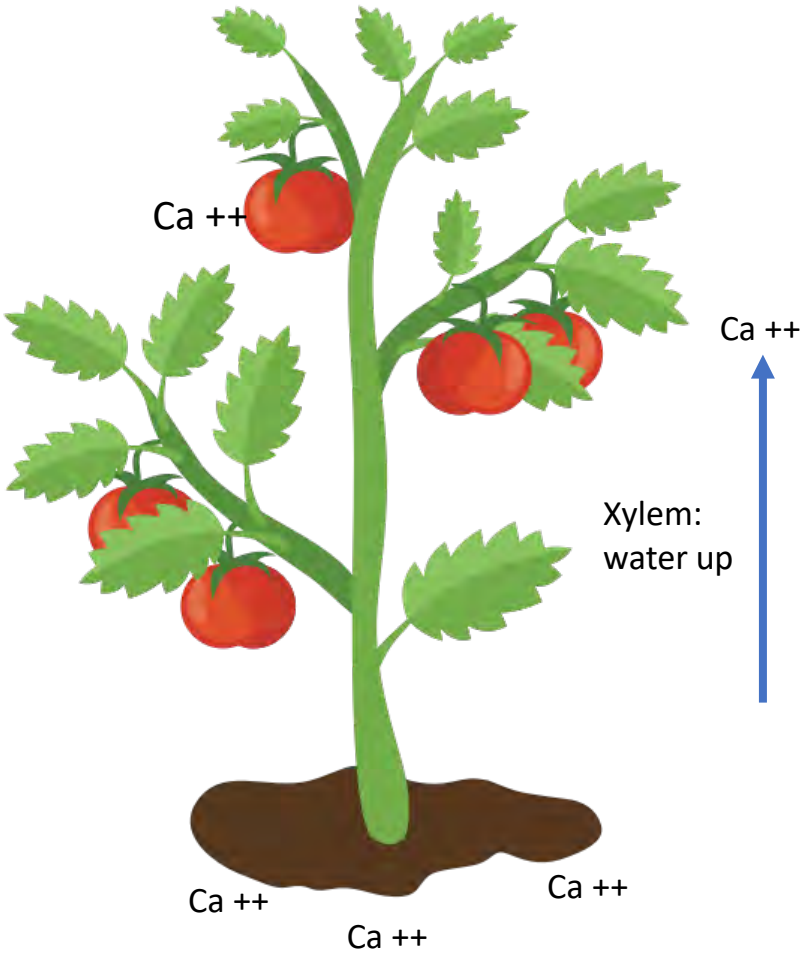
Blossom End Rot

- Disorder caused by plant stress
- Luxuriant growth followed by severe stress
- Cold, drought, intense heat
- Most is seen in the spring, fast, luxuriant growth and cool weather
- Cell death due to lack of Ca
- Two plant hormones interfere:
  - Gibberellins increase the problem
  - Abscisic acid (ABA) decreases the problem
- Can be caused by an actual lack of soil calcium, root damage from tillage or waterlogged soils, drought

Foliar Calcium Sprays for Blossom End Rot

- Foliar calcium is often recommended, but because it moves very little, it must be applied at proper growth stages to be effective.
- For example, for reducing blossom-end rot in tomato or pepper fruits, foliar calcium must be applied when fruits are very small.

- Best sources for foliar calcium are calcium nitrate (10 to 15 lbs./acre), calcium chloride (5 to 8 lbs./acre) and some chelated Ca products (manufacturers recommendations).



Controlling Blossom End Rot

- Soil test and follow soil lime recommendations
- Don’t force plant to grow too quickly
- Use low N fertilizers early on like 4-12-4
- **Mulch to reduce moisture evaporation**
- Drip irrigation on a timer can help
- Calcium sprays, if used, spray early in the season while fruit are small

Diseases

- **Early Blight**
- **Septoria Leaf Spot**
- Late Blight

- The Blights and Spots: prune diseased leaves, follow a regular spray schedule with effective fungicides.

- Timber Rot

- Timber Rot: Rogue them out, seal in a bag and dispose of them.

- Fusarium Wilt
- Verticillium Wilt

- Wilts: Rotate planting area, good drainage, buy varieties with resistance.

- Consider disease resistant varieties.

Hint: Avoid working in plants when they are wet. Diseases spread more easily.

Tomato Fungicides and Insecticides

Weekly preventative spray, rotate chemicals

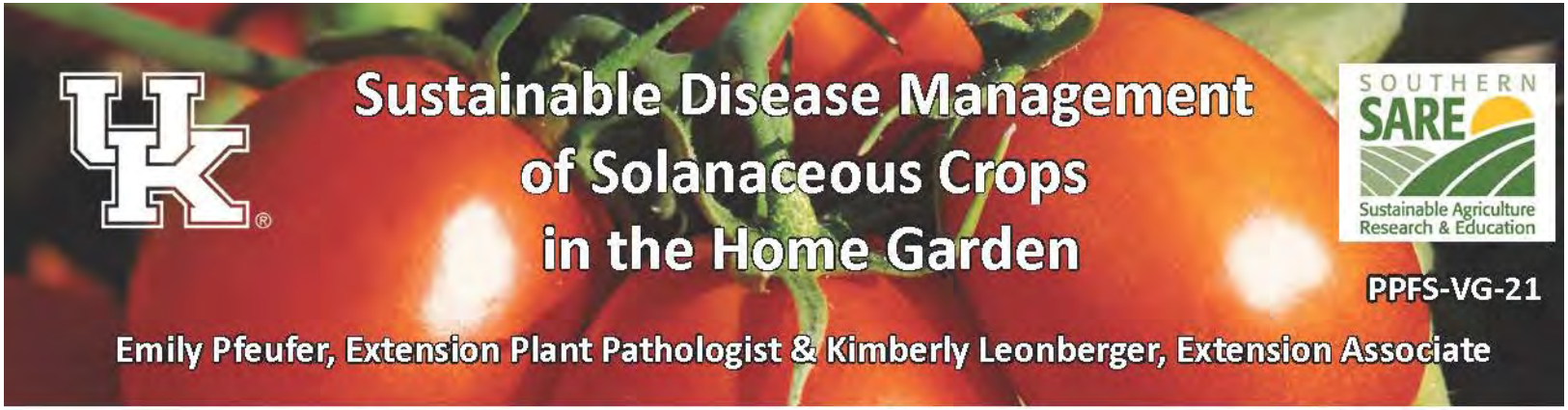
- Captan
- Daconil (chlorothalonil)
- Mancozeb
- Fixed Copper – Some formulations are organic approved – Use on bacterial spot/speck

- Neem Oil – Aphids, soft bodied insects
- Safer's Soap – Aphids and soft bodied insects
- Summer Horticulture Oil – Aphids, scale insects
- Bt (*Bacillus thuringiensis*), Dipel – young caterpillars
- Spinosad – insects
- Pyrethrum

Safest, low toxicity products

- Carbaryl - insects
- Pyrethroid insecticides (bifenthrin, cyfluthrin, and permethrin)
- Malathion – insects, sucking insects

Spider mites use a strong spray of water!



Sustainable Disease Management of Solanaceous Crops in the Home Garden

SOUTHERN SARE Sustainable Agriculture Research & Education

PPFS-VG-21

Emily Pfeufer, Extension Plant Pathologist & Kimberly Leonberger, Extension Associate

Time of Year[1]	Growth Stage	Cultural Management	Disease	Crops Affected	Chemical Management[5]
April-May (potatoes) May-June (all others)	Seeding (potato only) Transplant	Choose resistant or tolerant varieties; Avoid planting diseased plants; Plant certified or heat-treated seed; Rotate plants into a different area of the garden; Increase spacing between plants; Stake plants and use mulch to prevent soil from splashing leaves. Gray Mold- Lime excessively acid soils to promote calcium uptake.	Early blight[2] Gray mold Septoria leaf spot/blight Anthracnose[3]	Tomato/Potato Tomato Tomato Pepper/Tomato	Chlorothalonil or copper* or mancozeb (tomato and potato only) or sulfur[7]*
			Bacterial diseases[4]	Tomato/Pepper	Copper*
June	Vegetative growth	Remove infected leaves and destroy (do not compost); Remove weeds; Reduce/eliminate overhead watering; Stake plants and use mulch to reduce soil contact; Sanitize tools. Early blight - Ensure adequate potassium fertility.	Early blight[2] Septoria leaf spot/blight	Tomato/Potato Tomato	Chlorothalonil or copper* or mancozeb (tomato and potato only)
			Bacterial diseases[4]	Tomato/Pepper	Copper*
June-July	Blossom	Remove infected leaves/plant tissue and destroy (do not compost); Remove weeds; Reduce/eliminate overhead watering; Stake plants and use mulch to reduce soil contact; Sanitize tools. Early blight - Ensure adequate potassium fertility. Gray mold - Ensure adequate calcium nutrition.	Early blight[2] Gray mold Septoria leaf spot/blight	Tomato/Potato Tomato	Chlorothalonil or
			Bacterial diseases[4]	Tomato/Pepper	Copper*

July-August	Fruit bearing	Remove infected leaves/fruit/plant tissues and destroy (do not compost); Remove weeds; Reduce/elimnate overhead watering; Stake plants and use mulch to reduce soil contact; Sanitize tools. Early blight - Ensure adequate potassium fertility.	Early blight[2] Gray mold Septoria leaf spot/blight Anthracnose[3]	Tomato/Potato Tomato Tomato Pepper/Tomato	Chlorothalonil or copper* or mancozeb (tomato and potato only)
			Bacterial diseases[4]	Tomato/Pepper	Copper*
September	End of Season	Remove infected leaves/fruit/plants and destroy (do not compost); Sanitize metal stakes and cages.			

[1] Growth stage typically occurs during this time of year. However, time of year may vary from year to year depending on environmer conditions

[2] Confirm diagnosis of early blight as symptoms are often confused with blossom end rot (lack of calcium)

[3] Confirm diagnosis of anthracnose as symptoms are oftern confused with sunburn (environmental cause)

[4] Bacterial Diseases include bacterial canker (tomato), bacterial speck (tomato), and bacterial spot (tomato/pepper)

[5] Products approved by the Organic Materials Review Institute (OMRI) for organic production are noted with an *

[6] Avoid spraying chlorothalonil on blossoms, as it may pose a risk to honeybees

[7] Phosphorous acid and/or sulfur dust may injure plants; test on a small area, wait at least 3 days, and inspect for damage prior to treat entire planting.

Reviewed by: Dr. Shubin Saha, Department of Horticulture, University of Kentucky
Editor: Cheryl Kaiser, Extension Support
Photo credit: USDA-ARS

April 20

Timber Rot

- Begins in the stem
- Produces a long-lived, hard to kill survival structure called a sclerotia
- Best to bag up and remove!

Root Knot Nematodes

- Plants are stunted, yellowing
- Roots are gnarled, bumpy
- Can spread them on equipment so sanitize when moving to new area
- Use nematode resistant plants
- Reduce levels by solarizing with clear plastic, plant brassicas and marigolds, chitin mixed in soil, added organic matter, compost
- Don’t travel through dry soil

Tomato Issues

- Faye Kuosman, Extension Agent for Horticulture, Fayette County
- Video online at https://kentuckyhortnews.com/horticulture-webinar-wednesdays/season-one/

Check List

- ❑ Start with healthy transplants, disease resistant
- ❑ Choose sunny location, rotate location
- ❑ Animal control – consider fencing
- ❑ Well-drained soil, raised bed or container
- ❑ Soil test if planting in ground
- ❑ Prepare the soil, fertilize according to test
- ❑ Plant deep to get an early boost
- ❑ Practice good weed control
- ❑ Avoid moisture extremes, monitor soil
- ❑ Support: stake, cage, trellis
- ❑ Monitor daily – caterpillars, disease, aphids
- ❑ Remove diseased leaves from lower stem
- ❑ Follow weekly preventative spray schedule
- ❑ Fertilize every other week when tomatoes form
- ❑ Pick tomatoes promptly
- ❑ Pick early if prone to cracking, extremely hot
- ❑ Enjoy the fruits of your labor!

Saving Tomatoes for Winter

- Saving Tomatoes
  - Bring in, wrap in newspaper
  - Store in a cool location
  - Tomatoes from high tunnel saved in November finished in February