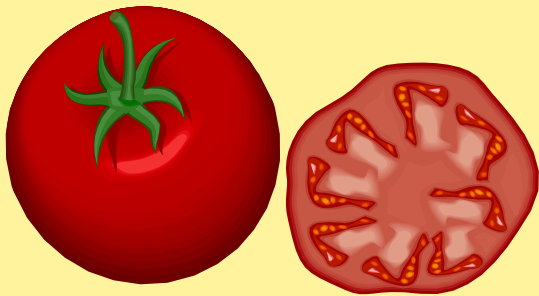


Guidelines for Growing Terrific Tomatoes



DR. STEPHANIE WALKER
EXTENSION VEGETABLE SPECIALIST



Tomatoes (*Solanum lycopersicum*)



- Most popular vegetable for home gardens
- Member of the Nightshade Family (Solanaceae) that also includes Eggplant, Peppers, and Potatoes
- Botanically classified as fruit (developed from an ovary), but officially recognized and treated as a vegetable
- Sensitive to frost; grown as a warm season annual crop



<http://www.grace-collection.com/images/Tomato.JPG>

History



- New World Crop
 - Native to tropical America - the Andes Mountains region of Peru and Bolivia
 - Wild tomatoes tended to be small-fruited, about the size of a cherry
- Mexico is region of domestication where different sizes, shapes, and colors were selected



History



- Seed was introduced into Europe by Italian explorers
- Tomatoes had an uneven introduction in Europe
 - Italians and Spanish embraced the new vegetable
 - French called it the **‘Love Apple’**



History



- English, aware of the relation to poisonous members of the nightshade family, were hesitant to eat the new vegetable
- The bias followed tomatoes to the Colonies
- Tomatoes were not widely cultivated in the US until about 1835
- Extensive commercial production began in the latter part of the 19th century



Tomatoes Today



- Tomatoes are popular in home gardens, community gardens and farmers markets; highly valued for the superior quality and flavor of freshly grown
- Unusual heirloom varieties add to the allure; tomatoes are diverse in color, shape and taste



So What's Up with NM-Grown?

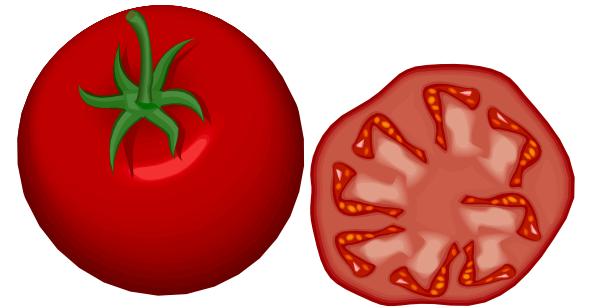


- Growing tomatoes in NM can be a challenge. Factors working against us include:
- High temperatures during peak growing period (optimum temps: 70-85°F day/ 65-70 °F night)
- Low humidity (requires higher transpiration rate)
- High light intensity (may result in fruit disorders)
- Poor soil conditions (optimum pH 6.0-6.5 / yield reduction at salinity >2.5 dS m⁻¹)
- Pests and Diseases

How to Grow the Best



PLANT THE RIGHT VARIETIES



Fruit Color



- Lycopene – red pigment (produced at 70-75°F; very little production >80°F)
-Warm growing areas often **produce ‘orange’ fruit**
- Carotene – orange
- Xanthophyll – yellow
- Chlorophyll – green
- **‘Purple Cherokee’, ‘Black Krim’ and others appear purplish because chlorophyll doesn’t completely break down during ripening**



Fruit Color



- A new, true purple variety is now available
- **‘Indigo Rose’** is newly released by Oregon State University
- Contains Anthocyanin – purple pigment
- **Don’t harvest too early;** wait until fruit go from shiny blue-purple to dull brown-purple



Hybrid vs. Open-pollinated Seed



- **Hybrid (F1):** The first-generation seed obtained from crossing two different inbred lines / plants
 - Seed is often expensive
 - Produces uniform, high yielding plants
 - **‘Saved seed’ will produce diverse plants**
- **Open-pollinated:** Seed produced through field pollination
 - Includes heirloom varieties

Vine Types



- **Determinate:** Bush-type, dwarf
 - Typically do not need caging or trellising
 - Best for container gardening
 - Tend to set fruit at same time
 - Tend to exhibit earlier maturity
- **Indeterminate:** Vining, pole-type
 - Benefit from staking, caging or trellising
 - Tend to set fruit over long period
 - Tend to have higher overall yields



Disease Resistance Designations

- V = Verticillium wilt
- N = Nematodes
- F = Fusarium Wilt
- FF = Fusarium, races 1 & 2
- A = Alternaria stem canker
- T = Tobacco mosaic virus
- St = Stemphyllium

Tomato Cultivars

- Plum and Small Types
 - **Smaller (1/2" dia.)**
 - Sweeter tomatoes
 - ~100 fruit/plant
 - Tend to be more disease & heat tolerant
 - **'Sweet 100'**
 - **'Yellow Pear'**
 - **'Tiny Tim'**
 - **'Black Cherry'**
 - **'Juliet'**



Tomato Cultivars

- Beefsteak
 - Larger tomatoes
 - Excellent for fresh use
 - Most susceptible to disorders; blossom end rot, cracking
 - **‘Beefmaster VFN’**
 - **‘Celebrity VFFNT’**
 - **‘Better Boy VFN’**
 - **‘Early Girl’**



http://jimmysbackyardgarden.com/images/photo_about.jpg

Tomato Cultivars

- Paste

- High ratio of solids
- Excellent for sauces

- **‘Roma VF’**
- **‘Viva Italia Hybrid’**
- **‘Amish Paste’**



<http://cornucopiaseeds.com.au/zencart/images/tomato%20indeterminate%20amish%20paste.JPG>

Tomato Cultivars

- Greenhouse

- Developed for optimum production and quality for greenhouse (and hoop house) production

- **'Arbason' F1**

- **'Cobra' F1**

- **'Geronimo' F1**



Tomato Cultivars

- Heirlooms

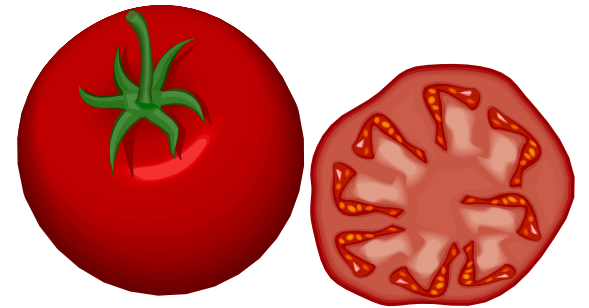
- Includes cherry, beefsteak, and paste types
- Older varieties
- Open pollinated
- ‘Brandywine’
- ‘Purple Cherokee’
- ‘Hungarian Heart’



How to Grow the Best



**OPTIMIZE
GROWING
CONDITIONS**



Create Excellent Soil



- Optimum soil will hold moisture, but is also well drained – incorporate organic matter
- Loosen down to 6-7 inches
- Remove large stones, other root obstructions
- Raised beds/container gardening – bring in soil - short term solution for bad soil
- Analyze soil for baseline nutrient content

Fertilization



- Essential elements derived from the soil

N: Nitrogen

P: Phosphorus

K: Potassium

10-10-10

- But also,
Calcium, Chlorine, Iron, Sodium, Zinc, Nickel,
Silicon Magnesium, Sulfur, Manganese, Boron,
Copper, Molybdenum

Tomato Fertilization



- Tomatoes are classified as heavy-feeders
- High requirements for potassium, calcium and iron
- Moderate requirements for nitrogen, magnesium, phosphorus, sulfur, boron, copper, manganese and zinc
- At soil pH > 7 , micronutrient deficiency often occurs (esp. zinc, manganese and iron)

Tomato Fertilization



- Small seedlings need less nutrition
- Excessive N fertilization before fruit set may inhibit fruit development
- Fertilizers specific for tomatoes are available:
8-32-16
6-24-24

Micronutrient deficiency symptoms



Expert Level: Fertilization



- Hydroponic tomatoes
- Runoff irrigation water is analyzed; fertilizer is adjusted accordingly
- pH of water is adjusted to 5.5 – 6.5
- Adjust nutrients based on plant growth stage.
 - Example: Potassium for tomato seedlings = 280 ppm;
at flower fruit set = 350 ppm



Water



- Water from below to avoid wetting foliage
- Keep soil at root level moist, especially during flowering
- Less frequent, deep watering encourages robust root growth
- Overwatering and under-watering both potentially harmful to production
- Mulch on soil surface helps maintain moisture

Apply Mulch



Pros

- Keeps weeds at bay
- Conserves soil moisture; may help prevent blossom end rot
- Keeps fruit off ground

Cons

- Could harbor pests
- Labor and cost investment
- Movement by wind



http://thailand.ipminfo.org/images/components/Organic_farm_egg_plant_mulching_3.JPG

Mulch – How to Apply



- Once plants are established, cover ground 2–4”
- Water to help settle
- **Don't cover plants (will lead to etiolation)**
- Types: Straw, leaves, wood chips, newspaper, pecan shells, compost, plastic
- Red colored plastic mulch has been shown to increase yields and/or hasten maturity in tomatoes

Season Extension



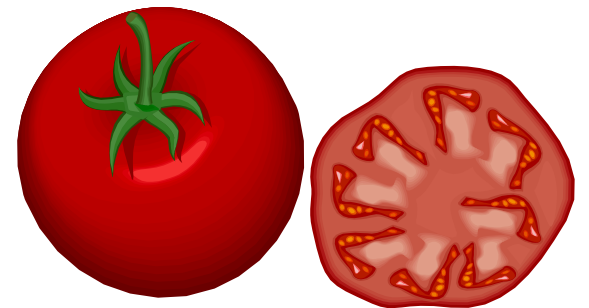
- Harvest can be extended into the fall - or seedlings can be protected early in the spring - by providing protection to plants
- Use milk jugs, paper caps, wall of water, row covers to protect from light frost
- Remove or open when temperature rises



How to Grow the Best



MANAGE PLANT GROWTH



Tomato Planting



- Direct seed or transplant
- Transplants preferred for earlier harvest
- Plant outside after last frost
- Plants should be placed or thinned to **12-24” spacing**

<http://www.hydroponics.com>



Planting - Seed



- **Sow seed approx. 1/2" deep**
- Protect unplanted seed from heat; seeds will be quickly killed at $>102^{\circ}\text{F}$
- If you save seed –
 - Gelatinous layer around seed inhibits germination and must be removed
 - Seed saved from hybrids will produce non-uniform plants

Planting - Transplants



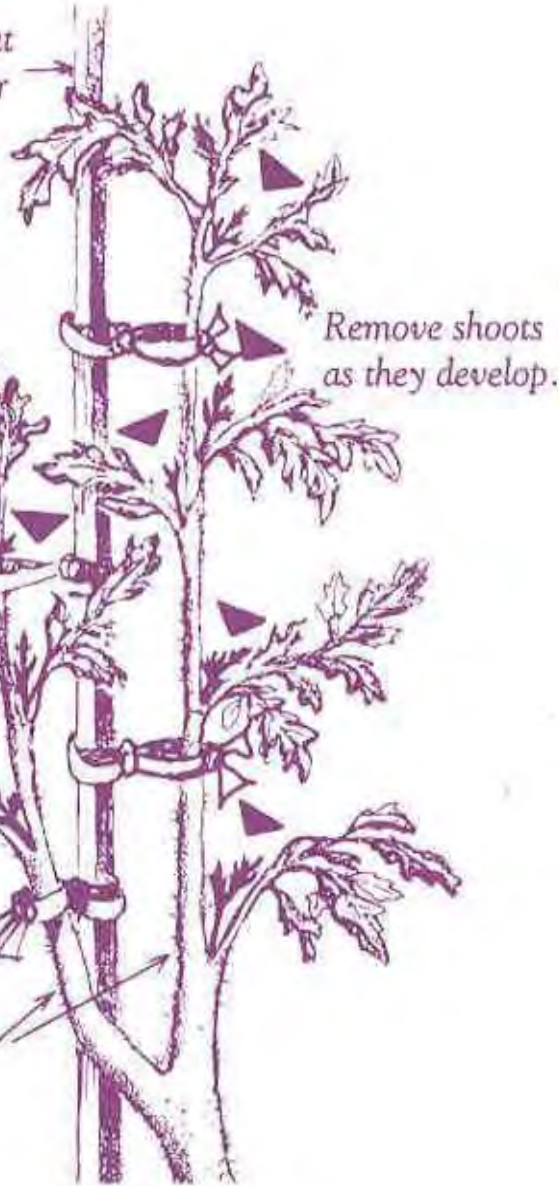
- When to start
 - Approx. 8 weeks before first frost free day
 - Start in clean potting soil or peat pots
 - Start by warm, sunny window
- Harden-off seedlings to minimize transplanting shock
 - Place outside in area partially protected from wind and sun for 1-2 weeks
 - Keep soil moist
 - Bring seedlings inside if freezing temperatures are predicted

“Trenching-in” long stemmed plants



-Encourages adventitious root development

Use a sturdy stake about 1-1½ inches in diameter and 6 feet long.



Remove shoots as they develop.

Tie plants using twine or strip of cloth.

Train to 2 main stems leading 1 up each side of stake.

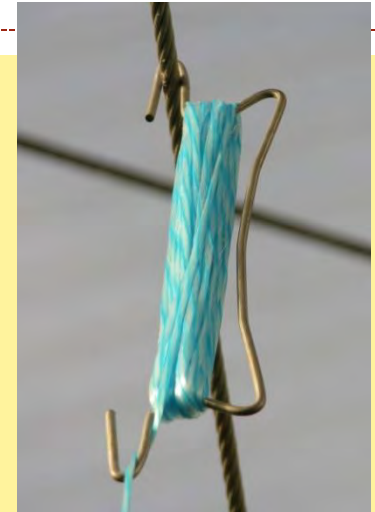
Pruning and Staking

- Indeterminate cultivars
- Leave two main stems
- Remove suckers between leaves and main stem
- Remove suckers before they get 2 ½ inches long
- Remove late season flower buds

Tomato Vine Training in Greenhouse



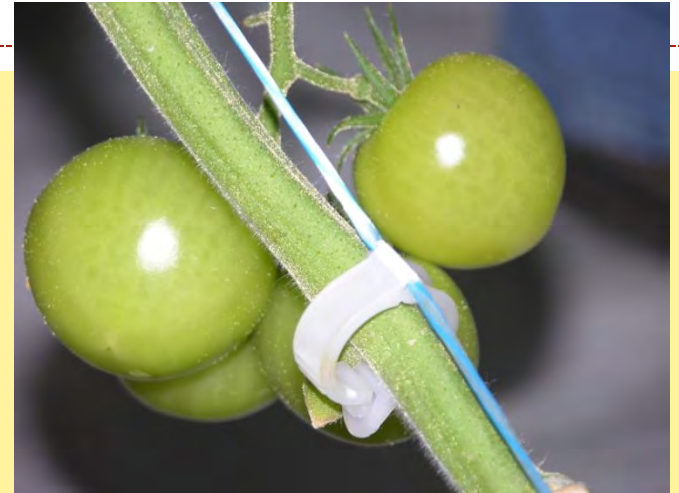
- Fruit are kept off the ground for optimum quality & to maximize space
- Vines are suspended from overhead supports
- Vines are raised to accommodate growth
- Suckers are promptly removed



Tomato Vine Training in Greenhouse



- Special supports are used to avoid damage to the vine



- Supports are available for heavy fruit, such as beefsteak-types



Grafted Tomatoes



- Grafted tomatoes are created when the top of one (scion) is attached to the root (rootstock) of another
- Scion is a variety that produces high quality fruit
- Rootstock is a variety that may:
 - take up water and/or nutrients more efficiently
 - be resistant to diseases or pests
 - be tolerant of salinity and/or water stress
 - provide resistance to temperature extremes



Benefits of Grafted Tomatoes



May Include:

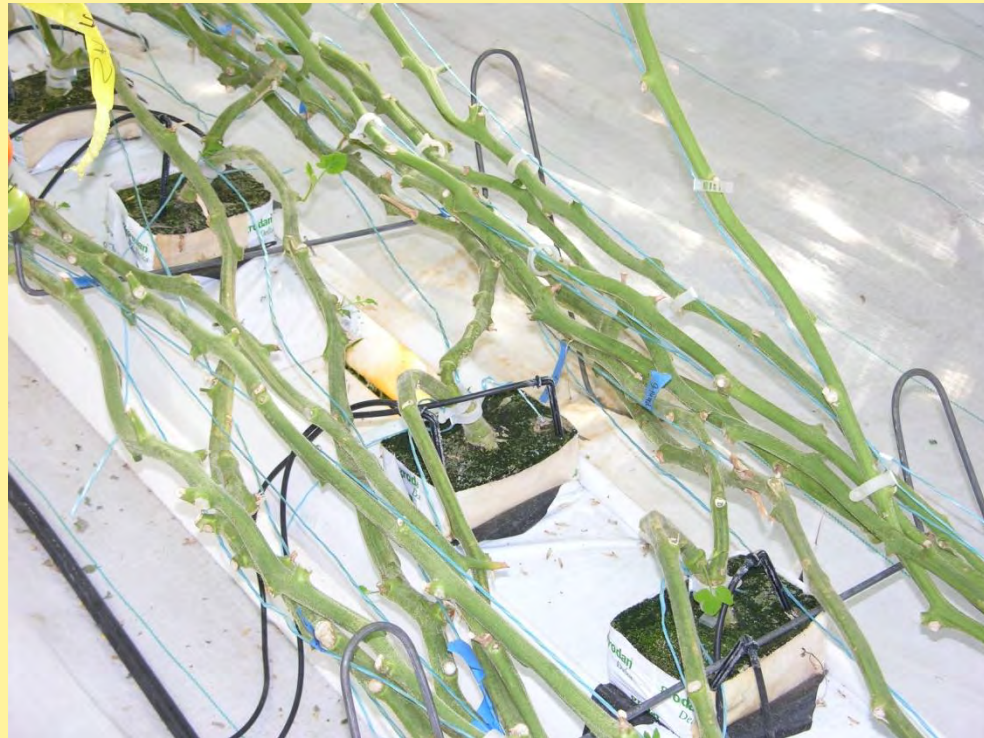
- Better quality fruit
- Higher fruit yield
- Increased plant vigor
- Resistance to some diseases
- Prolonged harvest

However, most diseases of tomatoes in NM will not be controlled with currently available rootstocks

Expert Level: Tomato Grafting



- Most high tech greenhouses use grafted tomatoes
- Producers commonly graft two scions to one rootstock



Fruit Set



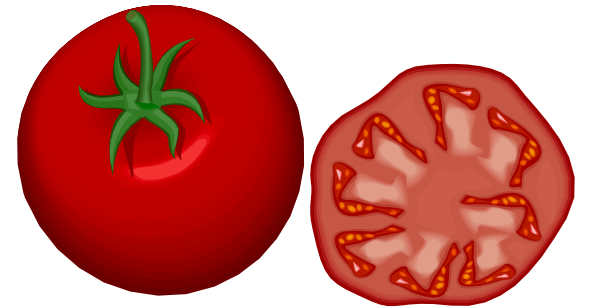
- Tomato flowers self-pollinate
-insect pollinators are not usually needed, but vibrating (or shaking) the flowers aids in pollen release
- In greenhouse, or with excessive shading, low light conditions can result in blossom drop
- Protected environment in greenhouses requires supplemental pollination for optimum fruit set (bees, plant vibrators)



How to Grow the Best



**MANAGE PESTS,
DISEASES &
DISORDERS**



Preventing Pest Problems



Scout

- At least twice a week
- Good to get down to plant level

Beneficials

- Insects that help keep pest insect populations down
- Attract with companion plants and habitat



http://share.triangle.com/sites/share-uda.triangle.com/files/images/IMG_4655%20copy.jpg

Companion Planting Guidelines



- Good: Asparagus, Chives, Onion, Parsley, Marigold, Carrots, Nasturtium



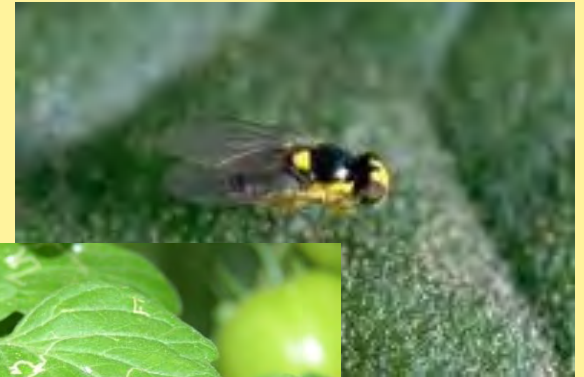
- Avoid: Brassicas, Potatoes, Fennel, Corn (both hosts to fruitworm)



Insect Pests



- Watch for thrips, flea beetles, whiteflies, aphids, hornworms, cabbage loopers, stink bugs, leafminers, spider mites



<http://www.homesteadingtoday.com/showthread.php?t=359342>

Insect Pests



- Insects are usually kept in check by natural predators
- Severe infestations can be treated with a variety of insecticides; follow label directions
- *Bacillus thuringiensis* (Bt) is an organically approved, non-toxic treatment for fruit worms

Viral Diseases



- Insects may vector disease
 - Thrips > tomato spotted wilt virus
 - Aphids > alfalfa mosaic virus
 - Beet leafhoppers > curly top virus
- *Tobacco mosaic virus is easily spread by humans; wash hands thoroughly after contact with tobacco products*

Curly Top Virus

- Only spread by Beet Leafhoppers
- Many weeds serve as reservoir
- Infects tomatoes, peppers, melons, spinach



Beet leafhopper
[Picture by J. Appleby]



Beet Curly Top Virus – Management Strategies

- Plant late
- Weed removal
- Insecticides
(not very effective)
- Kaolin clay (Surround)
- Shading
- Leafhopper exclusion



TOMATO CURLY TOP STUDY



LOS LUNAS--2008

**Covered vs Uncovered--
2008**



Courtesy of Dr. Ron Walsler

Curly Top Virus Exclusion-2008

YIELD/PLANT

COVERED-20 LBS

SURROUND-4
LBS

OPEN-.46 LBS



CURLY TOP CONTROL-2009



CURLY TOP CONTROL-2009

- YIELD/PLANT

- COVERED-40.4 LBS

- SURROUND-19.4 LBS

- OPEN-19.9 LBS



COVERING MATERIAL



- AGRIBON+ AG-15 INSECT BARRIER 10 FT X 250 FT = \$45.00
- AGRIBON+ AG-19 FLOATING ROW COVER 7 FT X 250 FT = \$45.00
- ANCHORING PINS BOX OF 500 = \$55.00
- JOHNNYSEEDS.COM
- 1-877-564-6697

Root Knot Nematode (RKN)



- Microscopic worms with wide host range
- Can be serious problem in sandy soil
- Usually reduces plant vigor / yield; may kill seedlings outright
- Limited control strategies:
 - Solarization
 - Crop rotation
 - Fallow rotation

Tomato roots: Healthy vs. RKN infected



Soil Solarization



- Non-chemical method to manage soilborne diseases, pests, and weeds
- Perform during summer months, 4-6 weeks duration
- Moisten, cultivate, remove weeds in area to be solarized
- Cover area with solid, clear plastic and seal edges with soil
- Soil temperature under plastic should reach a 130°F minimum



Disorders: Blossom End Rot



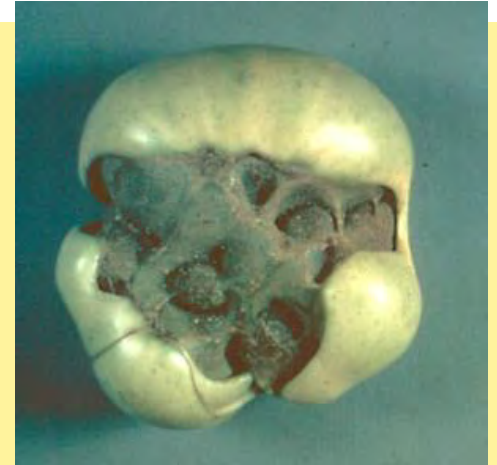
- Affects many vegetable & fruit crops
- Caused by Calcium (Ca) deficiency at actively growing point in fruit
- Uneven watering (calcium deficiency), and/or high temps ($>90^{\circ}\text{F}$) at fruit set are most likely cause



Disorders: Deformed Fruit



- Low temps ($<50^{\circ}\text{F}$) at fruit set cause fruit quality disorders; **'cat-facing'**
- Uneven pollination results in lopsided, irregular fruit
- Environmental stresses (heat, cold, water, pests, etc.) during fruit development almost always the cause
- Some varieties are more susceptible than others



Disorders: Deformed Fruit



- Greenback, can be caused by:
 - Potassium deficiency
 - Excess sunlight during ripening
- Blotchy Ripening, can be caused by:
 - Viral disease
 - Potassium deficiency
 - Excess heat during ripening



<http://gardener.wikia.com/wiki/Greenback>



Photo by [Timothy Coolong, University of Kentucky](#)

Disorders: Splitting Fruit



- Once fruit reaches mature color, outer epidermis cannot expand
- **High water input will cause fruit to ‘split’**
- Secondary fungal or bacterial pathogens **quickly infect ‘split’ fruit**



Disorders: Poor Fruit Set



- Insect or disease pressure may reduce fruit set
- Low light conditions can result in blossom drop
- Temps $< 50^{\circ}$ & $> 95^{\circ}$ F will prevent pollination and cause blossom drop
- Excessive nitrogen fertility will cause vigorous foliage but low fruit set (all leaves, no fruit)



Other Plant Disorders



- Leaf Roll
 - In absence of insects or disease, older leaves may **'roll'** due to wide swings between daytime and nighttime temperatures
 - **Normally doesn't harm the tomato plant**

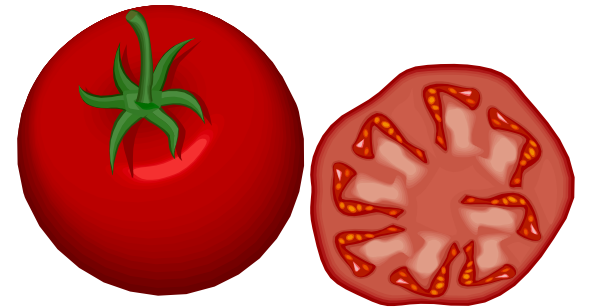
Minimize Plant Stress - Minimize Many Disorders



How to Grow the Best



OPTIMUM HARVEST AND STORAGE



Harvest and Storage



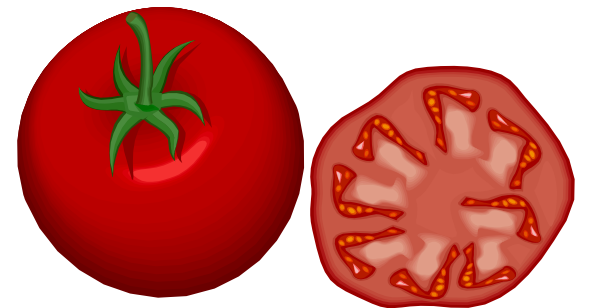
- For best flavor, harvest when fully colored on the plant, but before fruit begin to soften
- Keep harvested tomatoes at room temperature for best quality (refrigeration temperature inactivates ripening enzymes)
- Proximity to bananas, other ethylene producers, may accelerate over-ripening



How to Grow the Best



IN CONCLUSION...



To Optimize Your Tomato Success

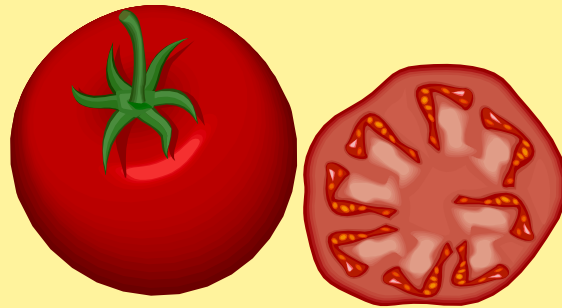


- Improve soil (must be well-draining, aerated; never compacted)
- Optimize soil moisture (never too wet or too dry)
- Feed your plants (but avoid excessive N)
- Strategic shading and/or season extension may create a beneficial microclimate
- Protect from insect pests and diseases
- Select high-performing cultivars

**Knowledge is knowing a tomato is
a fruit. Wisdom is not putting it in
a fruit salad.**



-BRIAN O'DRISCOLL, FEB 2009



How to Grow the Best



QUESTIONS?

