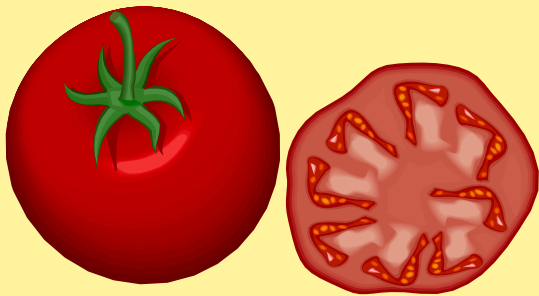


# Guidelines for Growing Terrific Tomatoes



**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 19<sup>th</sup> 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?

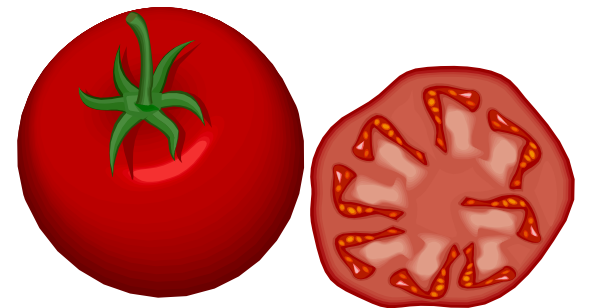


- Growing tomatoes in NM can be a challenge. Factors working against us include:
- High temperatures during peak growing period (optimum temps: 70-85°F day/ 65-70 °F night)
- Low humidity (requires higher transpiration rate)
- High light intensity (may result in fruit disorders)
- Poor soil conditions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

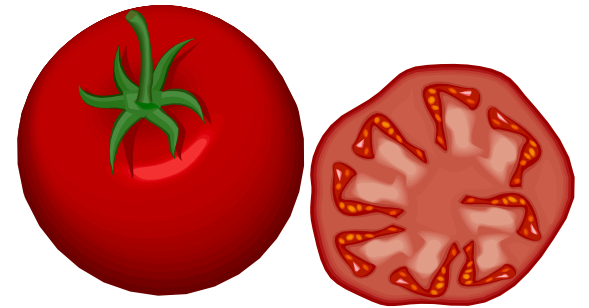
- Includes cherry, beefsteak, and paste types
- Older varieties
- Open pollinated
- ‘Brandywine’
- ‘Purple Cherokee’
- ‘Hungarian Heart’



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](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



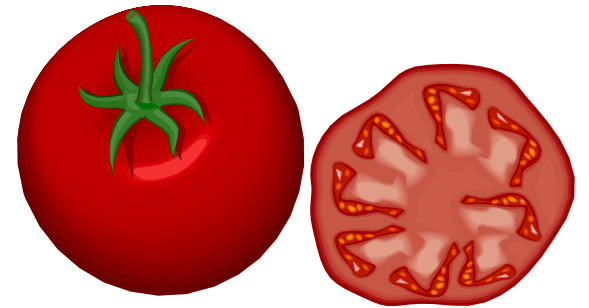
- Harvest can be extended into the fall - or seedlings can be protected early in the spring - by providing protection to plants
- Use milk jugs, paper caps, wall of water, row covers to protect from light frost
- Remove or open when temperature rises



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.



Tie plants using twine or strip of cloth.

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

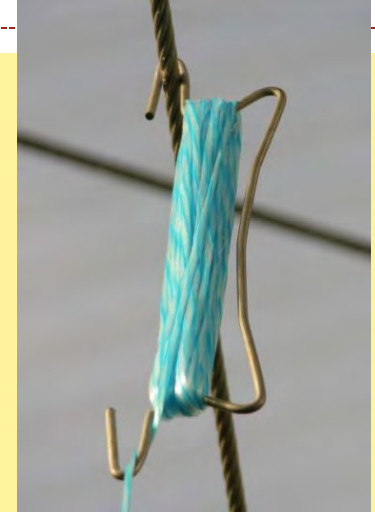
# Pruning and Staking

- 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:

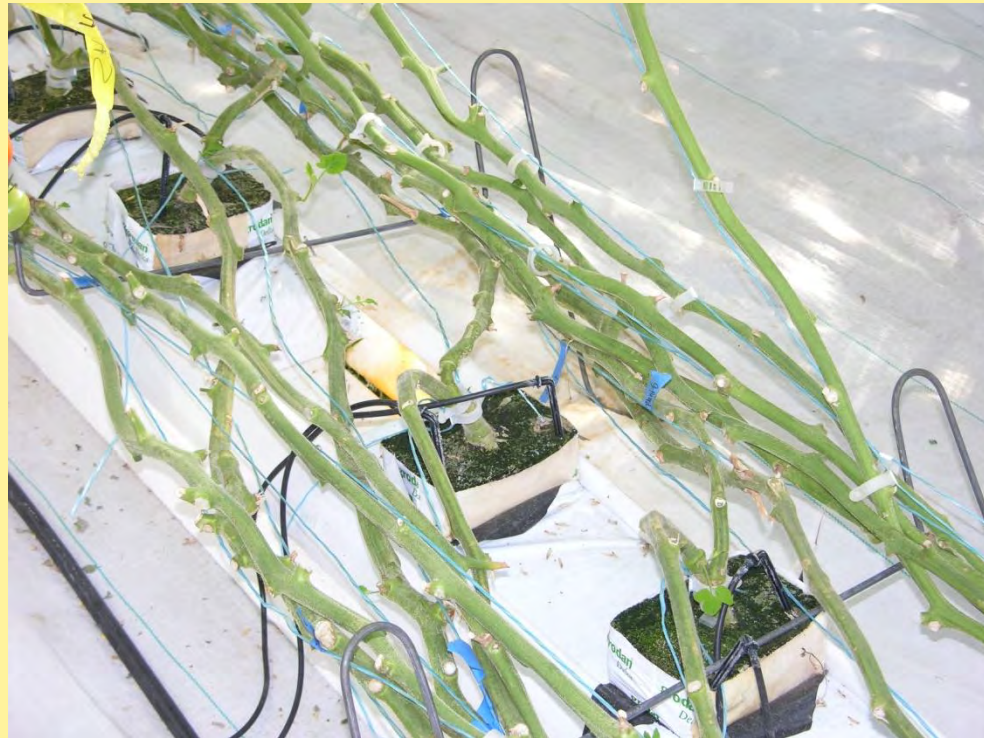
- Better quality fruit
- Higher fruit yield
- Increased plant vigor
- Resistance to some diseases
- Prolonged harvest

**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)

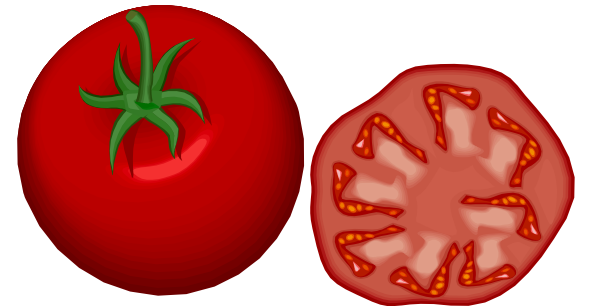




How to Grow the Best



**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](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



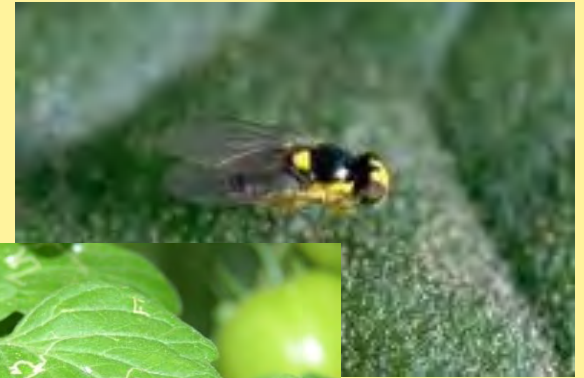
- Avoid: Brassicas, Potatoes, Fennel, Corn (both hosts to fruitworm)



# 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](http://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

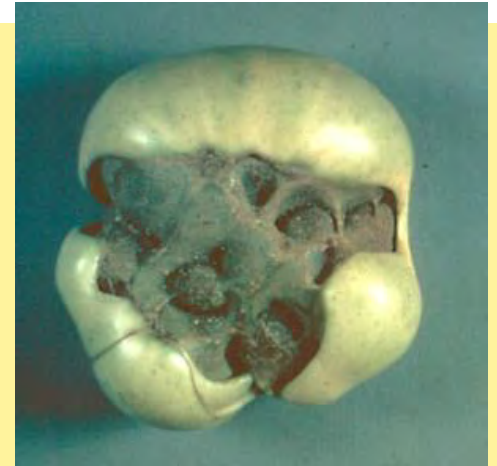




# Disorders: Deformed Fruit



- Low temps (<50°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**

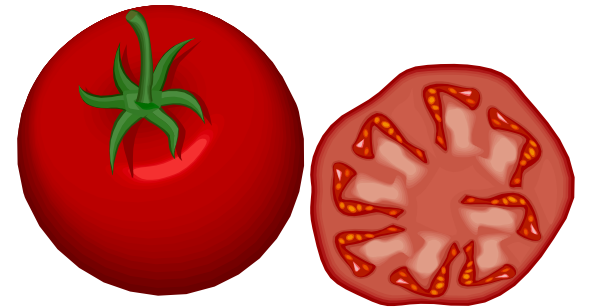
# Minimize Plant Stress - Minimize Many Disorders



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

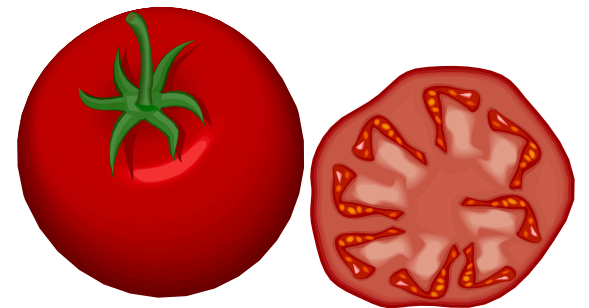




How to Grow the Best



**IN CONCLUSION...**



# To Optimize Your Tomato Success

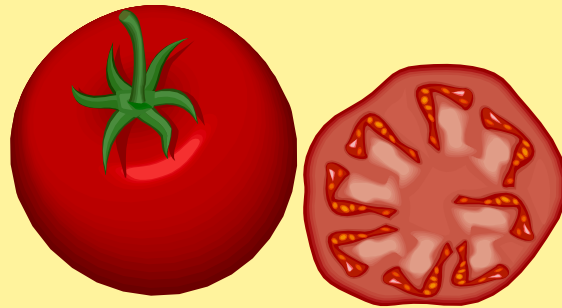


- Improve soil (must be well-draining, aerated; never compacted)
- Optimize soil moisture (never too wet or too dry)
- Feed your plants (but avoid excessive N)
- Strategic shading and/or season extension may create a beneficial microclimate
- Protect from insect pests and diseases
- Select high-performing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

