Guidelines for Growing Terrific Tomatoes

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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-ruited, about the size of a cherry

- Mexico is region of domestication where different sizes, shapes, and colors were selected
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
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 (½” dia.)
  - Sweeter tomatoes
  - ~100 fruit/plant
  - Tend to be more disease & heat tolerant

- ‘Sweet 100’
- ‘Yellow Pear’
- ‘Tiny Tim’
- ‘Black Cherry’
- ‘Juliet’

http://farm4.static.flickr.com/3145/2594269346_64d6af8c2f.jpg
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’
Tomato Cultivars

**Paste**
- High ratio of solids
- Excellent for sauces
- ‘Roma VF’
- ‘Viva Italia Hybrid’
- ‘Amish Paste’

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

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

10-10-10
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. $\frac{1}{2}$” deep

- Protect unplanted seed from heat; seeds will be quickly killed at $>102^\circ$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
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
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 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 Walser
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

http://soilplantlab.missouri.edu/nematode/rootknot.aspx
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

http://polkmastergardener.ifas.ufl.edu/images/soil_solarized.jpg
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°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

Photo by [Timothy Coolong, University of Kentucky](http://gardener.wikia.com/wiki/Greenback)
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° & > 95° 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?