Growing Tomatoes – America’s #1 Garden Vegetable!

Ron Smith, Ph.D
Professor Emeritus, Horticulture
NDSU Department Of Plant Sciences

Tomatoes – All about Their...
- History
- Climatic Requirements
- Soil Requirements
- Fertilization Needs
- Starting from Seed
- Using Transplants
- Cultural Practices & some Cultivars
- Parasitic & Non-Parasitic Disorders
- Canning/Preserving

History of The Tomato
- Cultivated by Andes Indians in South America
- To Mexico some 3,000 years ago
- Introduced into European society 16th century – in Italy
- Tomatoes are botanically a fruit; used as a vegetable, not a dessert
- At first thought to be poisonous in America
- Thomas Jefferson grew tomatoes in his garden from 1809-1824, proving otherwise

Climatic Requirements
- Warm-season crop – plant after frost danger
- Solarize soil prior to planting for good start
- Low & high temperature sensitive – below 55° F & above 76° at night, blossom drop occurs
- Need full day of sun to be productive

Tomato Characteristics
- Tomatoes are a climacteric fruit
- Fruit will continue to ripen after harvest
- Factor that allows for unripened fruit to be shipped from long distances
- Tomatoes contain lycopene
- A non-nutritive phytochemical (carotenoid) that contains disease-preventing compounds
- Storing tomatoes in the refrigerator will negatively affect the texture and taste
- Only store in refrigerator when decomposition is imminent

Soil Requirements
- Deep, loamy, high organic matter content best
- Good tilth
- Ability to warm early; hold heat
- Free of rhizomatous weeds
- To amend heavy clay soil, use organic matter - i.e. sphagnum peat moss.
- Easily grown as a container crop
Fertilization Needs

- Soil test to determine nutrient status:
  - pH
  - NPK
  - Organic matter content
  - Soluble salts

- In absence of soil test ability, fertilize with 10-10-10 @ 2-3 pounds/100 square feet & work in 10-14 days prior to planting.

- At planting, a “starter solution” of Miracle-Gro will aid fast establishment.

Fertilization Needs, Cont’d.

- Do not use a lawn fertilizer as a source of nutrients – too high in N
- Never use a weed & feed combination!
- Tomatoes respond well to organic fertilizers due to slower release of nutrients over longer period of time.

Starting from Seed

- Don’t sow too early - common mistake!
- Direct seeding not recommended
- Start seeds indoors 4-6 weeks before last frost
- Always use a sterile or pasteurized media
- Bottom heat @ 75-80° F will result in faster germination; cooler air temp will build stocky plants
- Plant seeds no more than ¼” deep
- Mist or cover to keep soil moist; expect germination in 7-10 days.

Starting from Seed, Cont’d.

- Provide adequate, even light for seedlings
- Fluorescent lighting just a few inches above the tops of seedlings
- Do not overwater germinating seeds! Or damping off will be the result!
- Gradually condition seedlings outdoors before transplanting
  - Begin with 1 or 2 hours
  - Increase time slowly, until outdoors day & night

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Using Purchased Transplants

- Look for sturdy, straight-stemmed plants w/no flowers or fruit
- Set plants deeply when planting; remove any leaves that may be buried in soil
- Roots will develop along stem; starter fertilizer high in P may be used.
- Can be grown in Square Foot gardens @ 1’ x 1’ spacing and staked, or...
Tomato Transplants, Cont’ d.

- Staked in rows about 2” apart; in rows wide enough to accommodate cultivation equipment
- Unstaked plants should be mulched with straw to keep fruit off ground & prevent rot
- W/ space limitations, grow in containers that provide good drainage & use sterile or pasteurized media

Cultural Practices

- Uniform moisture supply important!
- Keep planting site free of weeds via shallow cultivation and/or mulching
- Staked plants are usually pruned to single or double stems; suckers removed
- Unstaked plants are allowed to grow & branch normally
- Staked plants provide fewer but larger fruit

Cultural Practices, Cont’ d.

- Monitor for insect/disease problems
- Physiological problems (i.e. BER) more common in modern cultivars due to poor cultivation techniques
- If destructive insects (i.e. tomato hornworm) are noted, hand pick or use least toxic insecticide for control
- Diseased plants should be rogued

Cultural Practices, Cont’ d.

- Drip irrigation best; always avoid splashing or overhead watering
- Avoid working among plants when foliage is wet from rain or morning dew
- Keep surrounding weeds eliminated or at least mowed

Cultural Practices, Cont’ d.

- Select seeds & transplants that are disease resistant:
  - VFNPA
    - V = Verticillium wilt resistant
    - F = Fusarium wilt resistant
    - N = Nematode resistant
    - T = Tobacco mosaic virus resistant
    - A = Alternaria stem canker resistant
- Try to rotate tomatoes to an area of the garden where crops were grown that are not in the night shade family:
  - Peppers, eggplant, petunias, potatoes

Cultural Terminology

- Indeterminate – vine keeps growing & produces flowers & fruits until frost
  - Examples: Early Girl & First Lady
- Determinate – plant grows to a particular height/size, sets fruit, & stops growing
  - Examples: Celebrity (AAS Winner) & Heinz
Plastic Mulch = Weed Control + Higher Yield

Plastic Mulches ~ Many Colors
- Red for crop uniformity and maximum yield
- Silver to deter flying insects
- Black for maximum weed control
- Olive - a “hybrid” of white and black, said to grow the best of both

Live In An Apartment? No Problem!

Photo Credits: Advance Greenhouses

Some Cultivars
- Early Season:
  - Early Cascade (I)
  - Early Girl (I)
  - Early Wonder (D)
  - First Lady (I)
  - Oregon Spring V (D)
  - Bush (D)

- Mid Season:
  - Better Boy Hybrid (I)
  - Big Beef (I)
  - Big Boy Hybrid (I)
  - Cabernet (I)
  - Celebrity Hybrid (D)*
  - Health Kick (D)

*Celebrity is used as a comparison standard against other cultivars in trials

More Cultivars...
- Late Season*
  - Russian (I)
  - Super - Blacklake (I)

*Use later season cultivars with caution due to early fall frosts in our region, be prepared to cover!

- Potted (ideal for salsa making)
  - Clasica (D)
  - La Roma (D)
  - San Marzano (I)
  - Super Italian Pesto (I)

Small Fruited
- Juliet Hybrid (I)
- Sugar Snack (I)
- Sweet 100 Hybrid (I)
- Sweet Million Hybrid (I)

Parasitic & Non-Parasitic Disorders
- Parasitic – Septoria leaf spot
  - Begins on lower leaves after the first fruits are set
  - Spots are circular, with dark margins and gray centers, with tiny black dots in them
  - Yields are reduced and exposed fruit may be more susceptible to sun scald
  - Prevent by avoiding water splash during irrigation or working among plants when wet
Progression of Septoria Symptoms

- Initial symptoms begin on underside of older leaves
- Enlarge and coalesce
- Final stage where pycnidial fruiting bodies are evident

Parasitic Disorders, Cont’ d.

- Early Blight (Alternaria solani)
  - Appears first on the lower leaves, as “target spots” up to ½ inch in size.
  - Entire infected leaf will turn yellow & drop.
  - Rainy weather & temps @ 75 – 85°F promotes development & spread.
  - Disease can spread to fruit, causing premature fruit drop.
  - Most common late in growing season.

- Late Blight (Phytophthora infestans)
  - Uncommon disease in ND; western MN.
  - Night temps in the 50’s & heavy dew favor development.
  - Daytime temps of 86° or higher are unfavorable to late blight development.
  - Greasy, black spots begin spreading in from leaf edge.
  - Wet weather promotes disease & fruits may also be infected.

Parasitic Disorders - continued

- Bacterial Speck & Bacterial Spot
  - Not a major concern to ND or western MN tomato growers.
  - Be on lookout for development of small black spots on underside of leaflets, surrounded by a yellow halo.
  - Disease can be carried on seed.
  - Best to rouge any plants showing infection.

Bacterial Diseases of Tomato

- Bacterial spot causes raised lesions on the fruit; symptoms first on leaves.
- Further rotting is rare; avoid using seed from previous season, follow good cultural practices.
- Bacterial speck has smaller lesions on fruit that is not raised.
Parasitic Disorders, Cont’d.

- **Virus Diseases – TMV, CMV, & SWV**
  - All cause a mottling & distortion of foliage
  - Sometimes affects fruits
  - Not common in region
  - TMV may be seed-borne & spread by smokers
  - CMV commonly spread by aphids & mechanical injury
  - SWV is spread by larval stage of thrips
- Rouge any plants showing virus symptoms

### Symptoms of TMV
Look for light and dark green streaking on foliage

### Symptoms of Cucumber Mosaic Virus (CMV)
CMV symptoms produce shoestring foliage Which can resemble 2,4-D drift damage

### Symptoms of Spotted Wilt Virus
SWV results in mottled fruit; necrotic, Orangey-red fruit tissue

Insects
- Aphids
- Cutworms
- Flea beetles
- Hornworms
- Leaf miners
- Salk borer
- Tomato fruitworm

### Tomato (tobacco) Hornworm
- Adult Moth
  - Emerges early summer
  - Formed in late summer, emergence occurs the Following spring
- Pupa
- Larva

Photo Credit: Cornell University Fact Sheet
Tomato Fruitworm – aka – Corn Earworm

Mating adult moths

Eggs – left, tomato fruitworm; Right, cabbage looper

Larva feeding on tomato; Usually found on stem end

Beneficial (predatory) insects; Big-Eyed Bug & Minute Pirate Bug

Photo Credits: U.C. IPM

Insects - continued

Most are easily controlled if caught early; tomato hornworms can simply be picked; cutworms can be thwarted at planting with collars of wax paper or aluminum strips. Stalk borer can be located and killed in the stem above entry hole.

Others can be controlled with Insecticidal Soap, forceful water sprays, or low toxicity insecticides, if no predatory insects are found

Non-Parasitic Disorders

- Blossom End Rot
- Sunscald
- Physiological Leaf Roll
- Growth Cracks
- Catface
- Herbicide Injury

Photo credit: Cornell University Fact Sheet

Non-Parasitic Disorders

All are the result of weather conditions or cultural practices
- Wet, cool weather
- Excessive fertilizer
- Excessive pruning
- Being overzealous in weed cultivation
- Herbicide injury – 2,4-D & related growth regulator herbicides being used on adjacent turf can cause injury
- Symptoms can mimic virus diseases

Blossom End Rot – Various Stages

Leaf roll occurs during cool, wet weather, excessive fertilizing, and pruning. It has no effect on the quality or quantity of the crop

Non-Parasitic Disorder – Physiological Leaf Roll

Photo credit: Purdue University
Non-Parasitic Disorder - Catfacing

Catfacing occurs with low temperatures during flowering and fruit set, resulting in poor pollination. Excess heat and 2,4-D drift can also cause this malady. More frequent on older cultivars and/or large-fruited cultivars.

Controlling Plant Disorders

- Select only healthy transplants; do not save seed from any infected fruit
- Rotate
- Avoid excessive cultivation near plants
- Don’t over-fertilize
- Avoid splashing water on foliage
- Control weeds & insects in area surrounding garden
- Practice IPM!

Canning & Preserving

- To protect against microorganism contamination, add lemon juice whenever canning without the use of pressure processing.
- pH of canned product or salsa needs to be @ pH 4.3 or lower
- Add 2 tablespoons of bottled lemon juice, or ½ teaspoon of citric acid per quart of tomatoes.
- Sugar – 1-2 teaspoons may be added to offset acid taste
- For more information on canning & freezing tomatoes go to: http://www.est.nodak.edu/extpubs/yf/foods/he175w.htm#Canning

Conclusion – Why Tomatoes?

Eating tomatoes* may:
1. Lower risk of prostate cancer in men
2. Lycopene, beta carotene, & lutein – all carotenoids, which are all anticarcinogenic
3. Good sources of vitamins A & C
4. Widely used in many ethnic and non-ethnic foods, easily prepared and good tasting

*Mild processing appears to improve assimilation of lycopene – such as a topping on pizza!

What About Peppers?

- Same basic cultural requirements, except they are fussier:
  - Start seeding about 2-3 weeks earlier for transplanting
  - Require warmer temperatures at transplanting for successful production
  - Temperature and moisture fluctuations can cause fruit abortion; unusually warm nights can inhibit fruit set (>70 F)
Hot Pepper Growing Tips
- Similar cultural guidelines as tomatoes
- Because peppers root shallowly, the use of plastic mulch may lead to uprooted plants
- Harvest by cutting off stems or carefully bending stems toward the direction they curve
- Greater production will result if peppers are harvested as they ripen

Hot Pepper Characteristics
- Capsaicin is an anti-oxidant and anti-coagulant
  - Thought to be beneficial for blood circulation and the curing of diseases
  - Peppers are very high in vitamin C and vitamin A
  - Some hot types have more vitamin C than citrus fruits
- Fruit should be shiny, firm, and brightly colored
- Store fruit in the refrigerator for best preservation
- Peppers change color and intensify their taste
  - Bells sweeten and turn from green to red, orange, yellow
  - Hot peppers get hotter and turn from green to red

Hot Peppers & Capsaicin Oil
- Fat soluble alkaloid compound that concentrates in seeds and placenta of the fruit
  - Only foods that absorb fat will relieve the intensity of hot peppers
  - Bread, cheese, rice, milk
- Oil content increases and becomes concentrated with hot and dry weather conditions
- Level of heat also depends on pepper variety and level of maturity

Scoville Units
- Method of measuring heat of capsaicin oil by diluting oil from a pepper variety with drops of water
  - The number of drops of water it takes to dilute the heat to an undetectable level
  - 16,000,000 Scoville Units in pure capsaicin.
### Pepper Problems
- Blossom end rot – same cause as with tomatoes – slow calcium mobility in plants
- Aphids during hot, dry periods
- Bacterial diseases
- TMV – select resistant cultivars
- Sunscald – plant closer together; also reduces weed pressure
- Fruit set can be inhibited from overhardening

### Pepper Variety

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<th>Scoville Units</th>
<th>Pepper Variety</th>
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<tr>
<td>16,000,000</td>
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<tr>
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<tr>
<td>0 - 100</td>
<td>Bells, Sweet Romenes, Pimento</td>
</tr>
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### The World’s Hottest Pepper Bhut Jolokia: 1 million Scoville Units!

A 28-year-old Indian woman smeared its seeds on her eyes before gobbling up 51 fire-hot Bhut Jolokia peppers in two minutes...

> “Anandita Dutta Tamuly performed the feat Thursday, cheered on by celebrity British chef Gordon Ramsay who was visiting India’s northeastern Assam state for a television shoot for his new global food series.”

> “Ramsay tried a bite of the chili - and ended up regretting it; ‘it’s too much,’ he pleaded for water”

### Tomato and Pepper Cultivars to Consider

- **Tomatoes:**
  - Cherry – sweet 100 & sweet million
  - Small Fruited Slicing – Early Cascade, Early Girl, Oregon Spring, Ultra Sweet
  - Main Season – Market Pride, Empire, Mountain Fresh. Research has shown slightly higher yields from staking than not staking.
- **Peppers:**
  - Sweet – Lady Bell, Boynton Bell, and Emerald Isle
  - Chili – Delicas, Giant Jalapeno, Hungarian wax, Large red cherry, & Hot Portugal

### Plant & Enjoy These Healthy Vegies!

### Final Admonition!

- Experiment with varieties (cultivars) in your location; what will grow well in one area will not necessarily grow well in another
- Rotate, rotate, rotate. Select those that are listed as having resistance bred into them
- Do not save the seed – it is not worth it!