



# Tomato Love!

*Dona Lee  
Colleen Kennedy*

**April 2020**

 **Virginia Cooperative Extension**  
Virginia Tech • Virginia State University

 **MGNV** Master Gardeners of Northern Virginia  
Arlington • Alexandria • [mgnv.org](http://mgnv.org)

# Virginia Cooperative Extension (VCE) & Master Gardeners of Northern VA

- Volunteers serving Arlington & Alexandria
- Promoting public education on environmentally sound gardening practices since 1985 through:
  - **Help Desk Support via email**
    - mgarlalex@gmail.com
  - **Plant Clinics at Arlington/Alexandria, Farmers Markets and Libraries**
  - **Free Classes**
    - <https://mgnv.org/category/public-education-events/>
  - **Demonstration gardens,** incl. organic vegetable garden
  - **Online resources:** [www.mgnv.org](http://www.mgnv.org)
    - Search tip — site:edu, site:gov

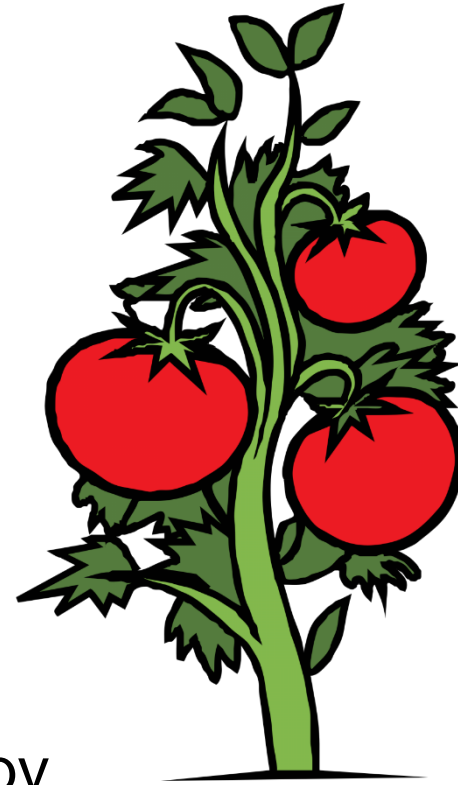
**NOTE: Surveys collect information to verify our community service and need for continued funding. Please complete!**



Potomac Overlook Organic Vegetable Garden

# What We'll Cover

- History of the Tomato
- Tomato Economics
- Growing Choices
- Planting
- Seed Starting
- After care: Keeping Tomatoes Happy
- Problems: Diseases, Deformities & Pests
- Best Practices: Cultural and Environmental



# Tomato Provenance

- Origin: South and Central America; domesticated in Mexico; desert plants
- Mayans and Aztecs cultivated. “Tomatl” means round and plump in Nahuatl
- Brought to Europe by the Spanish (1535); to the east (1604) and South Africa (1850) by the Portuguese

- Not recognized as useful in US until 1800s
- French: pommes d’amour (love apple)
- Italian: pomo d’oro (golden apple)
- Afrikans: Tomatie;
- Malay: Tamatte



# Tomato: Love or Hate?

- Solanum (nightshades) Lycopersicum (wolf peach)
- Nightshades: Potatoes, Tobacco, Eggplant, Chili Peppers, Belladonna “deadly nightshade”, Mandrake (hallucinogenic alkaloid)
- Black magic, poisons (pewter dishes), aphrodisiacs, exotic ornamentals
- Thos. Jefferson raised and ate in 1700s
- Campbell: Tomato soup 1890s
- James Peale 1826; “Still Life with Vegetables”



# Tomato Economics

- Second most consumed vegetable in the world
- World production: 161.7 mil. metric tons;  
USA production: 13.2 mil. metric tons
- World crop \$59 billion; USA \$5 billion
- Largest producers/consumers  
China, India, USA, Turkey
- 20-21 lbs. consumed per  
person per annum (US)

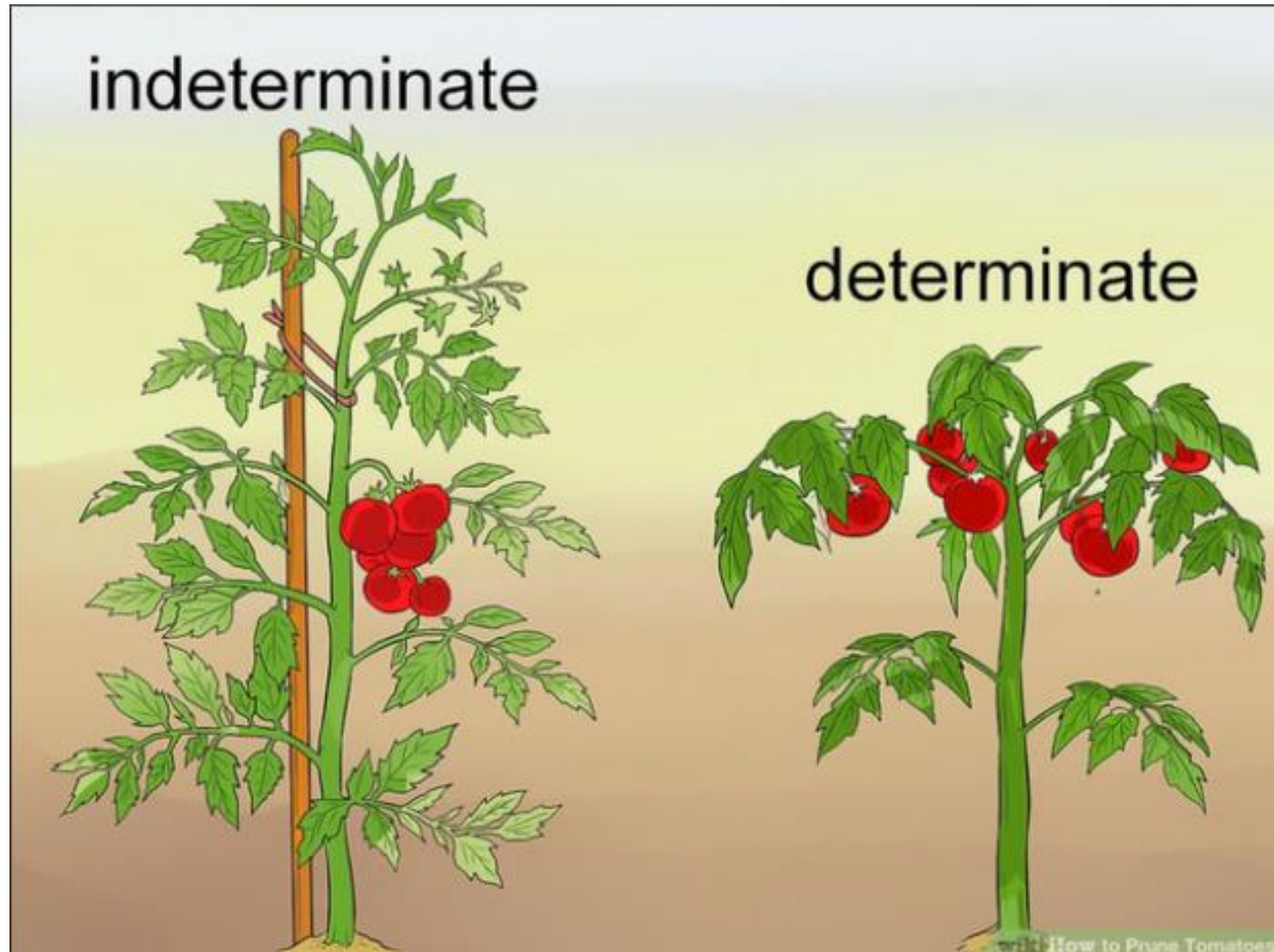


# Growing Choices

- Determinate, Dwarf or Indeterminate
- Hybrid or Heirloom
- Resistance
- Seeds or Plants
- In-ground, container, raised bed
- What do I plan to do with tomatoes



# Indeterminate vs. Determinate



# Plant Characteristics: Indeterminate vs. Determinate

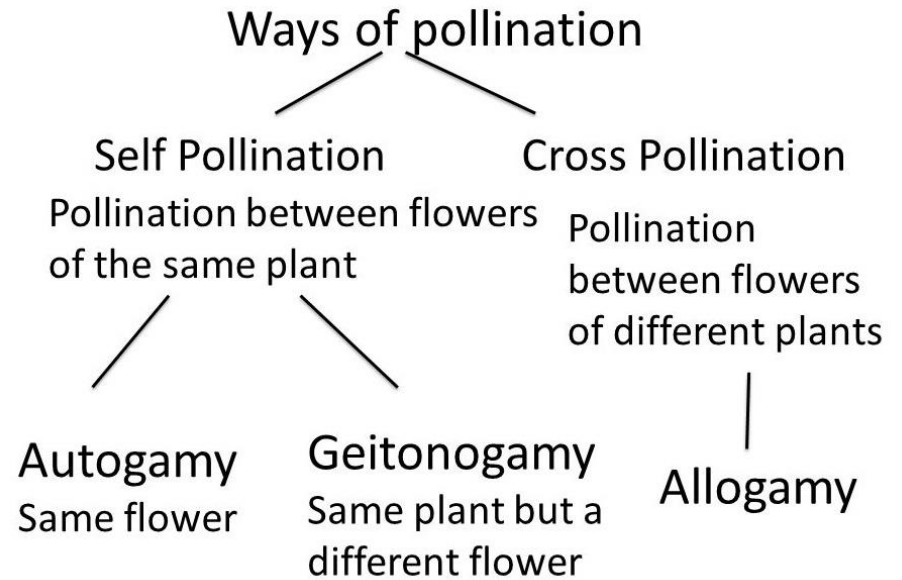
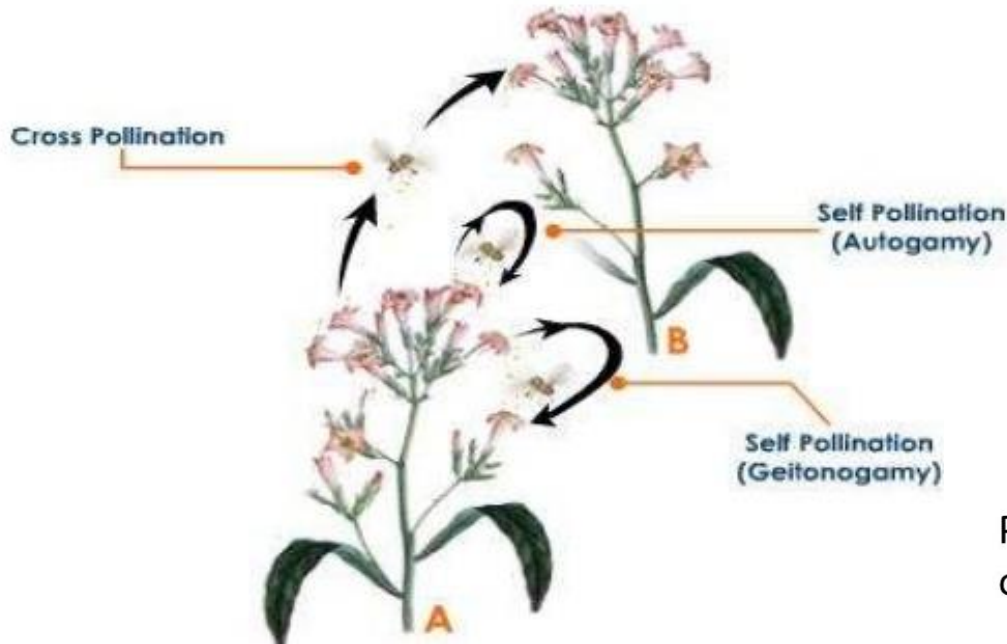
- Vine (Indeterminate)

- 3 – 4 leaves between flower clusters
- Shoot does not terminate in flower cluster
- Plant continues to elongate, grow larger
- Requires staking or caging
- Can grow up to 10 ft.
- Fruits ripen throughout growing season
- Grow until frost or disease kills them
- Dwarf is subset

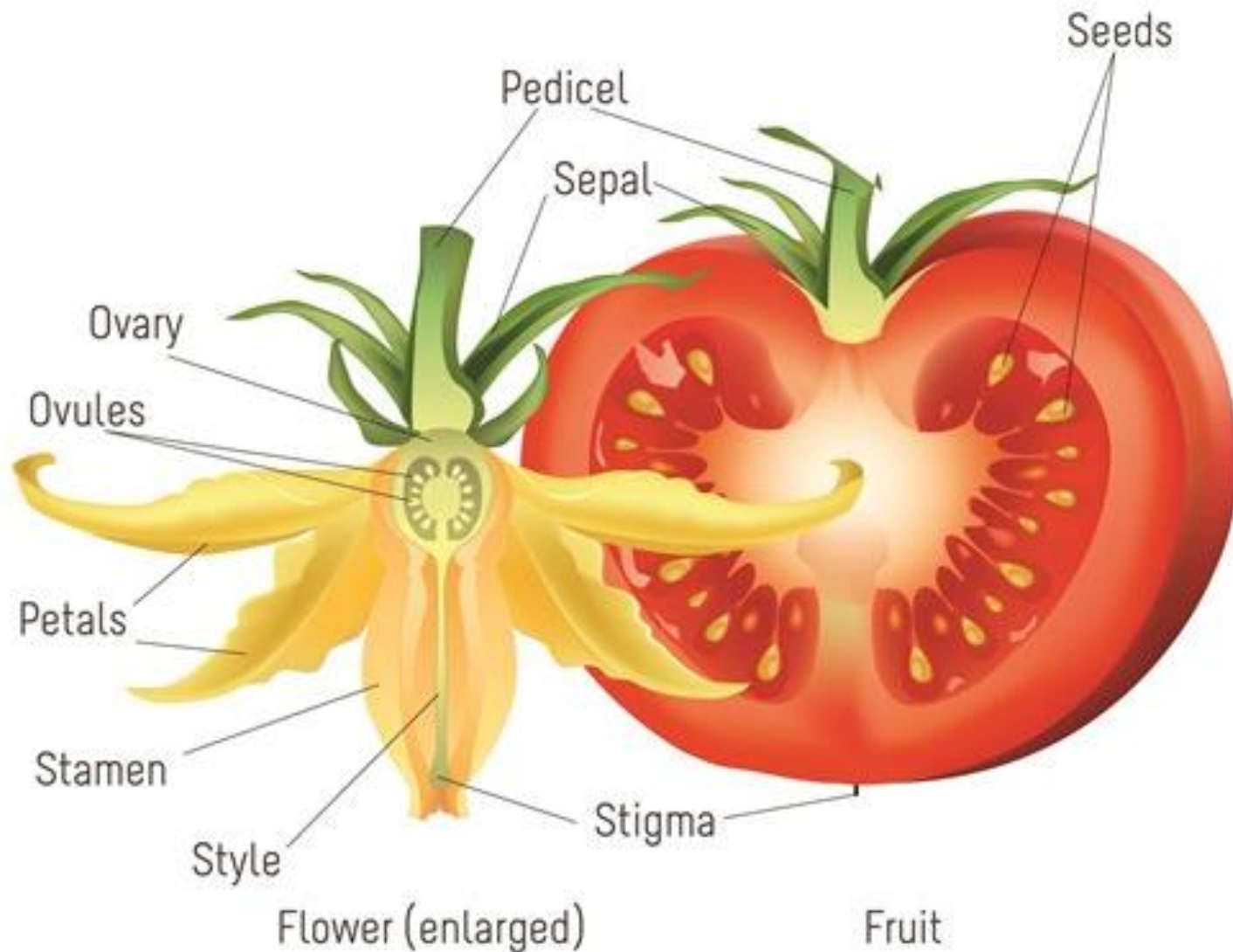
- Bush (Determinate)

- Flower clusters produced with 1 or 2 leaves between them
- After several clusters, shoots terminate in flower cluster
- Early-ripening
- Smaller plants; suited for caging or sprawling
- Typically grow to 4 ft.
- Fruit ripens all at once
- Reach a certain stage, set fruit and then decline
- Commonly used as patio plants

# Pollination

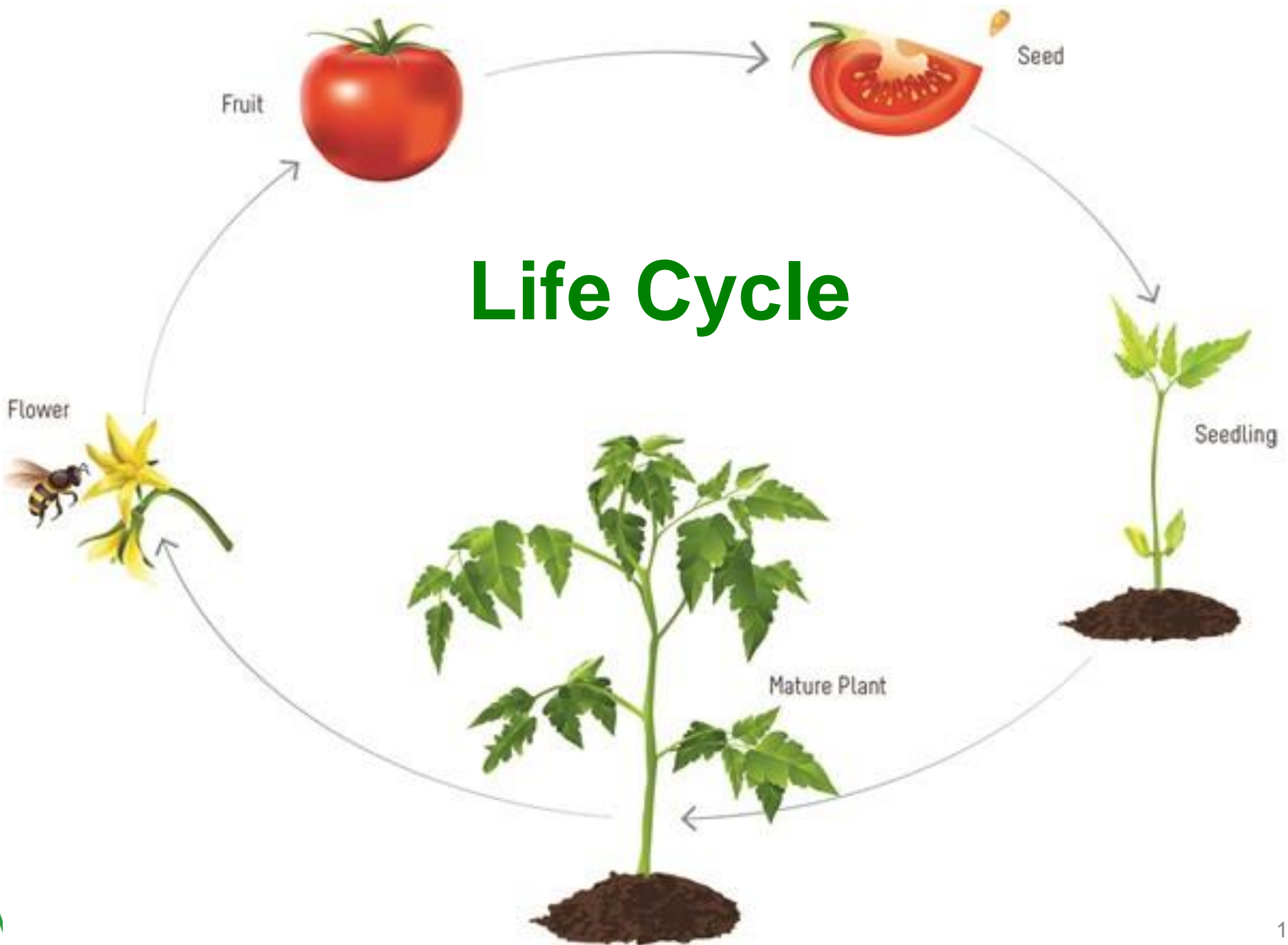


# Tomato Anatomy



# Hybrid vs. Heirlooms

- Created from 2 or more tomato varieties
  - Pros: harvest green, withstand shipping, maintain a good, uniform appearance; produce more tomatoes; more disease resistant
  - Will revert to one of the parents (not the combination) if seed is saved and planted
- Treasures from the past
  - Pros: outstanding flavor, color, or overall performance
  - Heirloom varieties are open-pollinated
  - Will remain true to the parent plant if seed is saved and planted



# Life Cycle

# Resistant Cultivars



|              | CHERRY                     | PLUM               | BEEFSTEAK                         |
|--------------|----------------------------|--------------------|-----------------------------------|
| Early Blight | Mountain Magic, Jasper     | Plum Regal, Juliet | Defiant PhR                       |
| Late Blight  | Prudens Purple, Mountain   | Plum Regal, Juliet | Iron Lady, Defiant PhR, Damsel    |
| Septoria     | Magic, Cherry Bomb, Jasper |                    | Mountain Merit                    |
| Fusarium     | Supersweet 100, Apero      | Tiren, Chiquita    | Celebrity, Marbonne, Marnero      |
| Verticillium | Supersweet 100             | Grandero           | Big Beef, Defiant PhR, Celebrity, |

## Purchase Disease-free Varieties



Crimson Crush F1



Mountain Magic F1



Lizzano F1

### *Tomato Disease Resistance Codes*

- V - Verticillium Wilt
- F - Fusarium Wilt (FF - Races 1 & 2; FFF - Races 1, 2, & 3)
- N - Nematodes
- T - Tobacco Mosaic Virus
- A - Alternaria Stem Canker
- St - Stemphylium Gray Leaf Spot
- TSWV - Tomato Spotted Wilt Virus

# Getting Started: Where to Grow Tomatoes

- Optimum Growing Conditions
  - 6-8+ hrs of sunlight
  - Good air flow & drainage
  - Adequate water supply
  - Wind protection
  - Healthy soil (soil test?)
    - o Prefers pH 6.5-6.8
    - o N-P-K balance
    - o Organic matter
- Some Choices
  - Traditional garden
  - Raised bed
  - Containers



# Growing Medium for Containers

- Select a high quality, organic potting mix
- Avoid garden soil
  - Insects, weeds, and disease
  - Clay holds too much water and too little air
- Avoid soilless mixes
  - Sterile with few nutrients
  - Too light to support plant roots
  - In light containers, taller plants may blow over
- Avoid mixes with water-absorbing polymer products
  - Can pull moisture OUT of tiny root hairs



# Growing Tomatoes in NoVA

- Length of growing season is important:
  - Avg. Last Killing Frost: April 1-10
  - Avg. First Killing Frost: Nov. 1-10
  - NoVa: Zone 7 (~180 day growing season)
- Typical maturity for tomatoes:
  - 52-90 days
- Tomatoes are a warm season crop:
  - 70 to 80 °F during the day
  - 60 to 70 °F during the night
- Plant transplants outdoors:
  - May 1-June 30



# What/How Many...Reality vs. Desire

- Consider where you will plant & how much space you have/will need
  - Traditional rows: 18-36" plant spacing; 24-36" row spacing
  - Raised bed/square foot: 18-24" plant spacing w/cages
  - Containers:
    - o Dwarf & Determinate varieties: 5 gal container
    - o Indeterminate: 10 gal container
- Grow what you like to eat:
  - Basic Fruit Types: Cherry, Beefsteak, Paste, Winter Storage
  - Colors: Red, Pink, Green, Orange, Yellow, Black/Purple Stripe



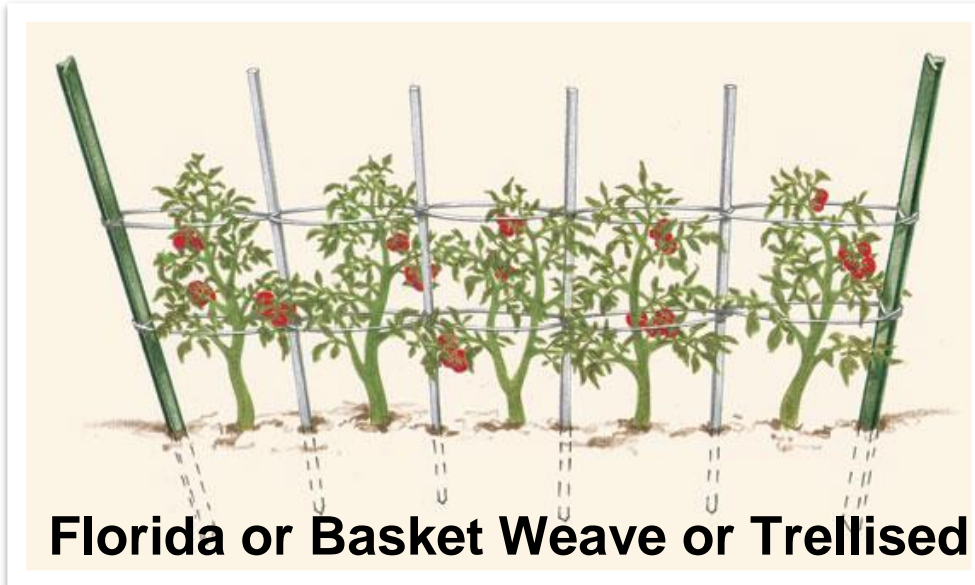
# Tomato Supports



**Staked  
Tomatoes**

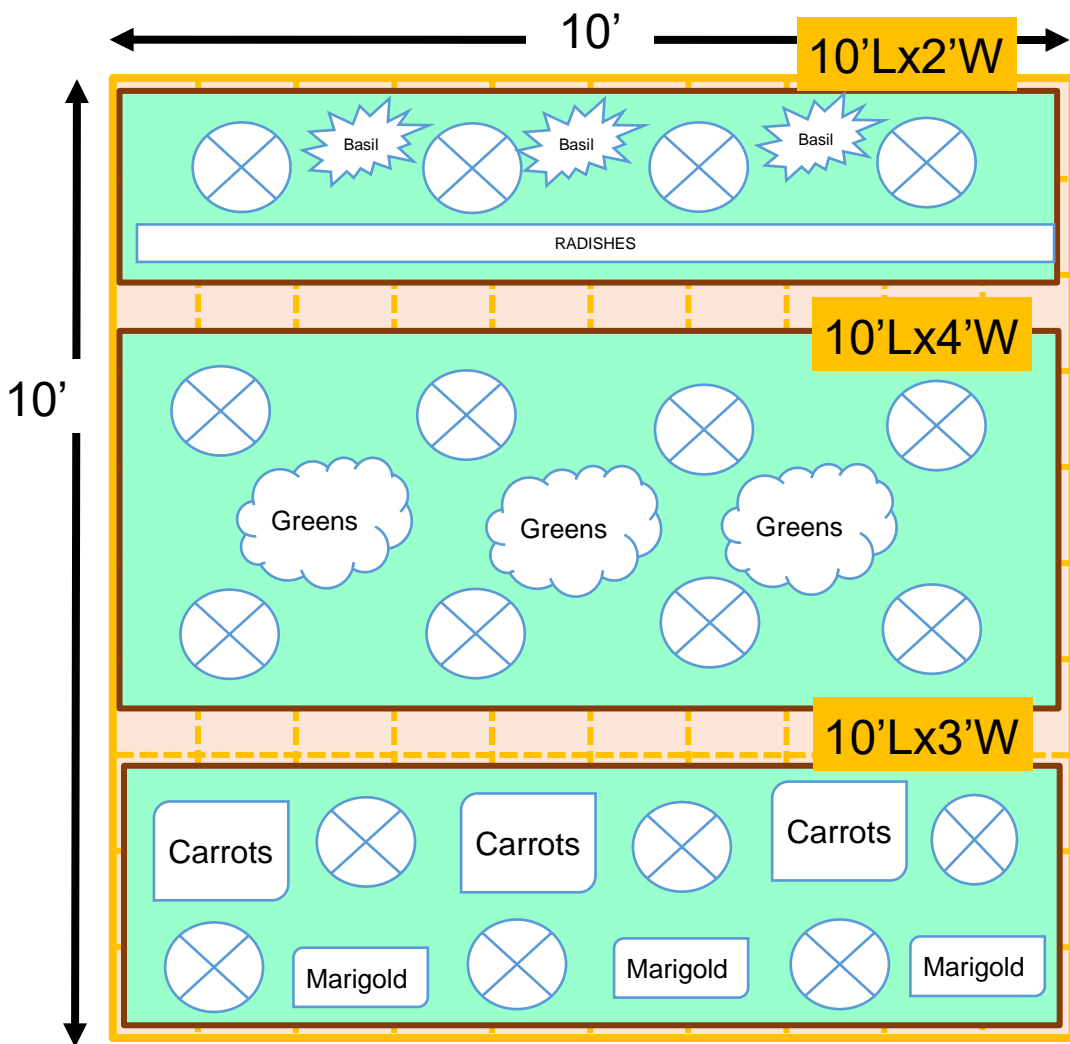


**Caged  
Tomatoes**



**Florida or Basket Weave or Trellised**

# Sample Layouts/Companion Planting



- Use space between plants to add other vegetables, herbs, or flowers in rows, beds, or containers:
  - Vegetables: lettuce, carrots, onions
  - Herbs: parsley, chives, basil
  - Flowers: marigolds, nasturtiums
- Do not intercrop with:
  - Vegetables: brassicas (e.g., broccoli, kale), corn, dill, or potato
  - Herbs: fennel

# Purchasing Transplants

- You don't want an especially tall spindly, yellowed or rootbound plant
- Check:
  - underside of leaves for spots, or insects
  - general vitality of the plant
  - growing container – Is the plant root bound?



# Seed-Starting Supplies

- South facing window or grow light(s)
- Seed-starting soil
- Containers
- Tray with cover or plastic wrap
- Tomato seeds;  
seeds viable for 4 years
- Spray bottle with water
- Heat pad (optional)
- Fan or other air source



More Info: VCE Publication 426-001 Plant Propagation From Seed

# Planting Seeds

- Can start seeds indoors 1 Mar-1 May
- Fill your container with seed-starting mix and add 2-3 seeds to each section or container and soak with warm water
- Then cover lightly with additional soil and cover with plastic top or plastic wrap and place in warm place to germinate or on heat pad or refrigerator top
- Keep moist but not soaking wet; remove top or wrap if condensation forms and drain off.
- Your seedlings should poke through in 7-14 days with first set of leaves called seed or cotyledon (kädə'lēdn) leaves

# Caring for Seedlings

- Once you have your seed leaves, remove cover/plastic wrap and place in south-facing window or under grow lights for 12-18 hr daily
- Keep plants 1-2" from grow lights to avoid weak, leggy seedlings, turning frequently; put under fan for brief periods to toughen stems
- Water from the bottom but do not allow them to sit in water; it's best for plants to dry out a bit in between watering
- When seedlings have 1-2 real sets of leaves, transplant using potting soil into larger containers, 3" peat pots work well



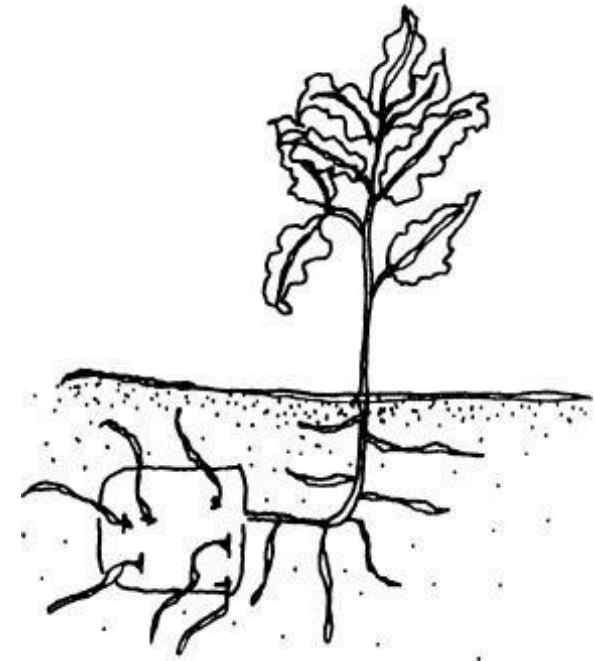
# Hardening Off Transplants

- Decrease watering & stop fertilizing 2 weeks before transplanting
- Lower temperature before transplanting
- Over 5-7 days, gradually expose to
  - Wind
  - Sunlight
  - Fluctuating temperatures



# How To Plant

- Plant mid-afternoon with expected evening temps at least 50 deg with no high winds or heavy rain
- Water transplants and gently remove from the pot; pinch off all but the very top 2-3 sets of leaves
- Dig a hole and place the plant into the hole up to the bottom leaves
- If transplants have an elongated stem, dig a shallow trench, and lay the tomato seedling in the ground horizontally, with just the top few inches showing above ground
- Press the soil firmly around the transplant so that a slight depression is formed for holding water
- Pour approximately one pint of diluted fish emulsion around each plant to wash the soil around the roots
- Set your tomato supports in place



# Fertilizing

- Use starter solution (dilute fish emulsion) for transplants.
- Side dress one to two weeks after the first cluster of tomatoes begins to develop with 10-10-10.
- Side dress again two weeks after the first ripe tomato; repeat one month later.
- Might be altered based on soil test.

# Care of Tomato Plants

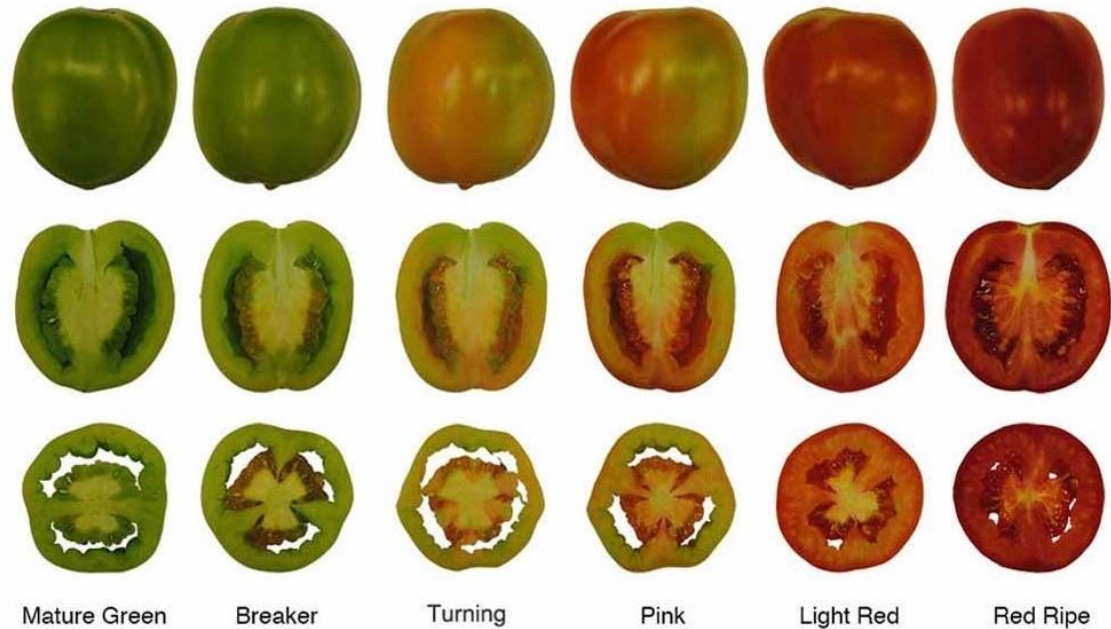
- Mulch around plants once established to keep down weeds, protect from high temps and keep in moisture
- Prune leaves 12" above ground to promote airflow; remove any yellowed or diseased leaves throughout the growing season
- Critical to water when flowering or fruiting
  - Water at base soaking thoroughly to ensure 1"/week if insufficient rain
- Optimum temperature: 65-85°
- Poor fruit set (proper pollination) if heavy rain
- Fruit set hampered by:
  - Day temperature >90°
  - Night temp > 70°



# Harvesting Tomatoes

- Ripening Progression:

- Mature green
- Color breaker
- Turning
- Pink
- Light red
- Red ripe



- Tomatoes do not need to be red ripe to harvest
- Clip tomatoes using shears – don't pull
- Remove the kalif (leftover stem) to avoid punctures; discard
- Don't overload tomatoes, large upon small, in your basket
- Separate split tomatoes from perfect and eat or roast
- Do not refrigerate ripening tomatoes

# Olla



# Tomato Diseases

- **Foliar Disease:** Early Blight, Late Blight, Septoria
- **Fruit Disease:** Anthracnose
- **Soil-borne, Root-delivered Disease:** Fusarium Wilt, Verticillium Wilt

# Early Blight



Concentric Or "Target"  
Lesions, 1/4-1/2"  
May Be Bound By  
Larger Leaf Veins

Leathery, Depressed  
Black Spots  
On Fruit



# Late Blight

Blue Grey Spots  
On Leaves



Brown Spots  
On Fruits



# Septoria lycopersici



- Appears on underside of lower leaves
- Spots circular 1/16 to 1/4 in diameter
- Centers with small black fruiting structures “pycnidia”
- Many spots per leaf

# Anthracnose



**Darkened, depressed lesions**

# Fusarium Wilt



- Girdling can develop on stem at its junction with root
- Very few tomatoes produced and plant often dies
- Signs:
  - Yellowing and wilting on one side of plant (could be leaf, single shoot, branch or several branches)
  - Lower leaves turn yellow and may fall off
  - Browning of vascular tissue(xylem), core remains healthy

# Verticillium Wilt



Brown Color  
In Xylem

Yellow  
Leaves



# Resistant Tomato Varieties

| Cultivar    | Disease Resistance/Tolerance |
|-------------|------------------------------|
| Beef Master | VT; F1; N; AS; M             |
| Better Boy  | VT; F1; N; AS                |
| Big Beef    | F12; GL; N; TM; VT; AS; EB   |
| Carnival    | F12; GL; N; TM; VT; AS       |
| Celebrity   | F12; GL; N; TM; VT; AS       |
| Floralina   | F12; GL; VT                  |
| Florida 47  | F12; VT                      |
| Jet Star    | F1; VT                       |
| Mt. Delight | F12; VT; BE                  |
| Mt. Fresh   | F12; VT; BE; EB              |
| Mt. Gold    | F12; VT                      |
| Mt. Pride   | F12; VT; AS                  |
| Mt. Spring  | F12; VT; BE                  |
| Mt. Supreme | F12; VT; EB                  |
| Pink Girl   | F12; GL; VT; AS              |
| Spitfire    | F12; GL; VT; EB              |



## LEGEND:

AS = Alternaria stem canker  
 GL = Gray leaf spot  
 BE = Blossom end rot  
 N = Root-knot nematode  
 EB = Early blight  
 TM = Tobacco mosaic  
 F12 = Fusarium wilt races 1,2  
 VT = Verticillium wilt

# Inoculum Reduction

- Remove and destroy infected plants (Do not compost)
- Get rid of harboring weeds which can act as overwintering hosts
- Rotate crops every three years
- Wash hands and disinfect tools



# Disease Mimics: Catfacing

Occurs at blossom end  
Inconsistent watering and cold temperatures when the plant is flowering



More prevalent in larger tomatoes and heirlooms

# Disease Mimics: Blossom End Rot

- Caused by Calcium imbalance usually as result of fluctuation in moisture (not enough water to get  $\text{Ca}^{+}$  to the plant)
- Too much Nitrogen
- Too high or too low pH



# Disease Mimics: Cracking and Splitting

- Excessive watering after drought
- Precipitous temperature change or temperature extreme
- Flesh grows faster than skin which splits
- Can be radial or concentric
- Cracks are portals for bacterial or fungal infections



# Disease Mimics: Sunscald

- Loss of leaves; excessive pruning
- Fruit becomes lighter in color and develops a papery texture



# Disease Mimics: Yellow or Green Shoulders

- Happens when lycopene production is inhibited
- Lycopene production ceases at temperatures greater than 80 degrees and above
- Proper airflow and ventilation can help



# Disease Mimics: Misshapen Fruit

- Inadequate Pollination secondary to:
  - Temperature and humidity outside ideal range
  - Lack of water
  - Nutrient deficiencies or toxicities
  - Low wind (lack of pollen transfer)



# Learn to ID Ones That Really Bug Us.....



**Cutworm**



**Cabbage Looper**



**Colorado Potato Beetle**



**Hornworm**



**Whitefly**



**Aphids**

# Insects Impacting Tomatoes

- Blister Beetles
- Hornworms
- Tomato Russet Mite
- Cabbage Looper
- Colorado Potato Beetle
- Cutworms
- Flea Beetle
- Whitefly
- Stink Bugs
- Grasshoppers
- Leaf footed Bugs
- Fruitworms
- Spider Mites
- Thrips
- Aphids

*Home Vegetables: **Organic Controls for Insects***

[https://www.pubs.ext.vt.edu/content/dam/pubs\\_ext\\_vt\\_edu/456/456-018/ENTO-289B.pdf](https://www.pubs.ext.vt.edu/content/dam/pubs_ext_vt_edu/456/456-018/ENTO-289B.pdf)

# Best Management Practices: Cultural

- Choose resistant cultivars
- Test soil for pH and nutrients and organic matter
- Aerate, add organic matter to improve soil and drainage
- Water in am with drip irrigation or soaker hose 1"/week
- Avoid injury to plants or their roots
- Don't overfertilize



# Best Management Practices: Environmental

- Mulch plants
- Avoid overcrowding (promote air circulation)
- Trellis or stake plants
- Consider using raised beds
- Add companion planting
- Right plant, right place





*"I need everybody to come down to the garden to cheer on the tomatoes."*

# References

- Relf et al. Tomatoes. VCE publication 426-418
- LeHoullier, Craig. Epic Tomatoes. Storey Publishing 2015
- Goldman, Amy. The Heirloom Tomato. Bloomsbury Publishing 2008
- Hillock, David et al. Growing Tomatoes in the Home Garden. OSU extension HLA-6012, 2017
- Johnnys Selected Seeds: Common Tomato Pests, Diseases and Physiological Disorders, Monograph, 2018
- University of Maryland Tomatoes Resource:  
<https://extension.umd.edu/hgic/topics/tomatoes>
- Michael, John. How to fertilize tomatoes. Monograph, OFAGS

# Tomato Diseases

|                               | <b>Anthracnose</b>                      | <b>Early Blight</b>  | <b>Late Blight</b>   | <b>Fusarium Wilt</b>   | <b>Verticillium Wilt</b>            | <b>Septoria</b>  |
|-------------------------------|---|--|--|--|-------------------------------------|--|
| <b>When Occurs</b>            | on green and ripe fruit                 | early to mid season<br>greatest damage after fruit set                         | mid to late season   |  |                                     | anytime in season  |
| <b>Part Of Plant Affected</b> | apparent on ripe fruit                  | leaves, flowers, stems and fruit   | leaves, petioles, stems, fruit                                   | xylem, leaves, stem  | xylem, leaves                       | stems, calyxes, blossoms   |
| <b>How Spread?</b>            | can colonize already compromised leaves | water, wind, tools<br>hands clothing insects                                   | airborne spores  | enters through broken roots<br>nematode damage   | broken roots, nematode damage       | water, wind, tools, hands, clothing, insects spread spores (conidia) |
| <b>Optimum Temp</b>           | 80                                      | 82-86  |  | 78-90  | 75                                  | 60-80  |
| <b>Conditions That Favor</b>  | wet weather, splashing water            | humid weather, heavy rainfall  | cool, wet  | excessive nitrogen   | cool wet soils                      | wet weather splashing water  |
| <b>Appearance</b>             | darkened depressed lesions              | target lesions, may be bound by leaf veins, dropped leaves result in sun scald | blue, grey spots on leaves, dropped leaves, brown spots on fruit | yellowing and wilting on one side of plant; leaves turn yellow and fall off; brown xylem | brown color in xylem. yellow leaves | multiple spots, yellow and brown, leaves may wither, pycnidia        |
| <b>Where Does It Live</b>     | infested tomato debris                  | plant debris, weeds  |  | soil   | soil                                | plant debris, solanaceous weeds                                      |
| <b>Resistant Varieties</b>    | No                                      | Yes  | Yes  | Yes  | Yes                                 | no commercial  |
| <b>Chemical RX</b>            | fungicides                              | fungicides   | fungicides   | none   | none                                | fungicide, copper  |
| <b>Fungus</b>                 | Colletotri-chum coccodes                | Alternaria solani  | Phytophthera Infestans   | Fusarium Oxysporum; Fusarium Lycopersici   | Verticillium albo-atrum             |  |



# Tomato Cultivation



## Planting

- Can start indoors 1 Mar-1 May
- Plant outdoors 1 May-15 June
- Space 18-30" apart
- Rows 30-48" apart
- Can be trenched
- Can interplant with lettuce and carrots
- Don't plant near black walnut root zone (*Juglans nigra* toxicity)

## Growth

- 6-12 days: tomatoes emerge
- Progression:
  - Green
  - Mature green
  - Color breaker
  - 1/2 ripe
  - Ripe
  - Red ripe
  - Full ripe
- 70-90 days: harvest
- 8-10 tomatoes per plant; dozens for cherry varieties

## Care

- Optimum temperature: 65-85°
- Prefers pH 6.5-6.8
- Critical to water when flowering or fruiting
- Poor fruit set if heavy rain
- Fruit set hampered by
  - Day temperature >90°
  - Night temp >70°
- Tolerates any day length but retarded with continuous light

## Fertilizing

- 2-3# complete fertilizer per 100 sq. ft. or based on soil test (6-24-24, 6-12-18, 8-16-16)
- Weeks 0-5 need N (Nitrogen);
- Weeks 6-12 (flowering) need K+ (Potassium)
- Weeks 12-20 (fruit set) need Ca+, Mg+ (Calcium, Magnesium)
- Side dressing of nitrogen after first cluster of flowers

## Facts

- Seeds viable for 4 years
- Tomatoes contain 35 calories each
- Contain vitamins A and C
- Carotenoid lycopene gives red color
- Types: Cherry, Beefsteak, Paste, Winter Storage
- Rootstocks for grafting (Beaufort, Maxifort, Big Power) confer resistance to TMV (Tomato M V) FW (Fusarium Wilt), VW (Verticillium Wilt), Nematodes, bacterial wilt, southern blight, corky root