

# Common Disease and Insect Pests of the Vegetable Garden

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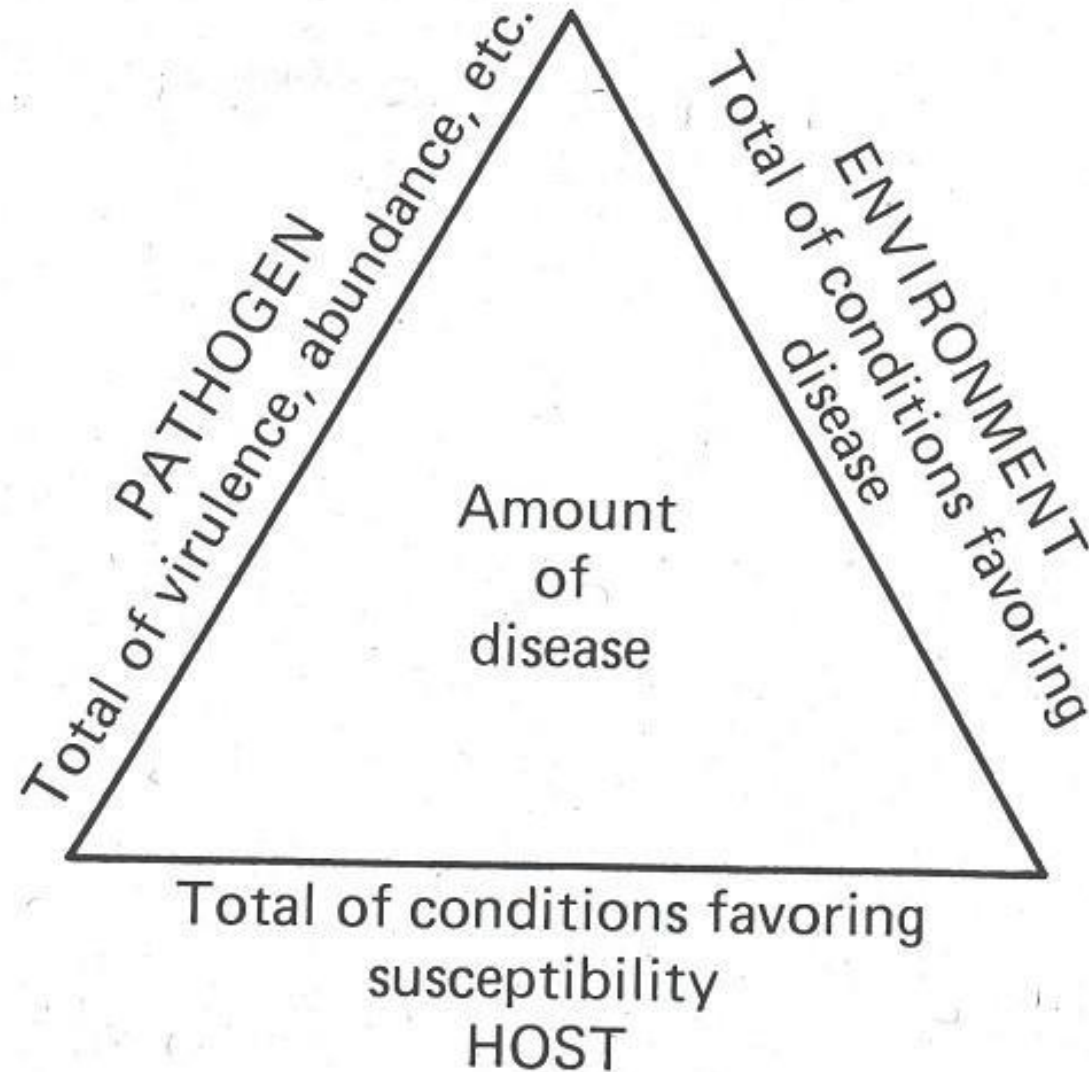
# Why did my plant die?

- Too hot
- Too cold
- Too dark
- Too wet
- Too dry
- Too crowded
- Too exposed
- Dog peed on plant
- Kids climbed it
- Staked plant, not staked
- Fed too much/too little
- Didn't water it
- Watered it too much
- Bought from Home Depot
- Dug it from the woods
- Pruned too much
- Pruned too little

# Where Did That Come From??

- Diseased plants
- Diseased plant debris
- Infected soil
- Contaminated water
- Airborne spores
- Infected propagation material
- Insect or mite vectors

# Plant Disease Triangle



# Integrated Pest Management (IPM)

- Planning a management program for landscape pests, disease and insects that uses all the tools available with a goal of achieving control using least toxic methods.
  - Reduce environmental stresses
    - Maximize plant health
  - Break the host-pest-environment triangle
    - Know the lifecycle of your pests and when to best control
    - Crop rotations and cultivar selection
    - Encourage beneficial insects
  - Take a pragmatic approach
    - How much damage can be tolerated?

# Ways to Minimize Pests

- **Cultural practices**
  - Optimize growth / reduce plant stress (compost, mulching, timing, fertility management, companion planting, rotation)
- **Mechanical controls**
  - Physical methods (tilling, sanitation, pruning, solarization, hot water)
- **Biological controls**
  - Encourage / introduce beneficial insects/organisms (control of vectors, introduction of beneficial fungi, bacteria, or nematodes)
- **Pesticides**
  - Insecticides, fungicides, herbicides

# Cultural & Preventative Controls

- Provide optimal growing conditions
- Avoid overhead watering and over-irrigation
- Practice good garden sanitation
  - Crop rotation
  - Debris cleanup
  - Avoid cross contamination- tools, soils
  - Don't work a wet garden
  - Control weeds
  - Purchase certified seed
- Time plantings optimally

# Cultural & Preventative Controls

- Plant selection
  - Plants adapted to our climate and soils
  - Use disease-free, insect free plants
    - Inspect plants before purchasing
    - Sturdy plants with well-developed root system
  - Select disease/insect resistant varieties
    - VF – verticillium wilt, fusarium wilt
    - Recommended varieties
- Soil preparation
  - Maintain correct pH
  - Insure adequate fertility
    - Incorporate organic matter



# Cultural & Preventative Controls

- Planting time
  - Plant to avoid peak insect infestation
    - Squash vine borers lay eggs in July
    - Eggplant Flea beetles have done their damage early
    - Plant Cucumbers late to avoid cucumber beetles
  - Plant early to reduce water needs
  - Plant when soil temperature provides quick germination
- Plant thinning
  - Overcrowding causes weak growth
  - Improves air circulation for quicker dry-down

# Cultural & Preventative Controls

- Watering
  - Amount, timing, method
    - 1 inch per week for adequate growth
    - Early morning to reduce dry-down
    - Drip irrigation prevents wetting of foliage
- Sanitation
  - Clean up refuse soon after harvest
  - Overwinter site for insects/diseases
- Weed control
  - Harbor pests
  - Compete for moisture and nutrients
  - Mulch
  - Sharp hoe, hand pulling, suppression

# Cultural & Preventative Controls

- Crop rotation
  - Do not plant related plants in same space year after year

Vegetables Grouped by Family					
Onions	Tomatoes	Beets	Cabbage	Peas	Squash
Garlic	Potatoes	Chard	Cauliflower	Snap beans	Cucumbers
Leeks	Eggplant	Spinach	Broccoli	Lima beans	Watermelon
Shallots	Peppers		Kale	Peanuts	Muskmelon
Chives			Collards		Pumpkin
			Turnips		
			Brussels sprouts		
			Radish		

# Cultural & Preventative Controls

- Interplanting
  - **Alternate groups of different plants within rows/patches**
    - Confuse insects looking to lay eggs
    - Reduces spread of diseases and insect infestation
  - **Companion plants**
    - Enhance growth
    - Attract beneficial insects
    - Repel harmful insects



INSECT PEST	REPELLING PLANT
Aphids	garlic, chives and other alliums, coriander, anise, nasturtium and petunia around fruit trees
Borer	garlic, onion, tansy
Cabbage moth	mint, hyssop, rosemary, southernwood, thyme, sage, wormwood, celery, catnip, nasturtium
Colorado potato beetle	green beans, horseradish, dead nettle, flax, catnip, coriander, tansy, nasturtium
Cucumber beetle	tansy, radish
Cutworm	tansy
Flea beetle	wormwood, mint, catnip, interplant cole crops with tomato
Japanese beetle	garlic, larkspur, tansy, rue, white geranium
Leafhopper	petunia, geranium
Mexican bean beetle	marigold, potato, rosemary, savory, petunia
Mites	onion, garlic, chives
Nematodes	marigold, salvia, dahlia, calendula, asparagus
Slug	prostrate rosemary, wormwood
Squash bug	tansy, nasturtium, catnip
Tomato hornworm	borage, marigold, opal basal
Whitefly	nasturtium, marigold

HERB	COMPANION FOR	PESTS REPELLED	INCOMPATIBILITIES
Allium	vegetables, fruit trees	aphids, carrot flies, moles, tree borers, and weevils	peas and beans
Basil	Tomatoes	Flies, Mosquitoes	Rue
Borage	Tomatoes, Squash, Strawberries	Tomato Worm	
Catnip	Eggplant	Flea Beetle	
Chamomile	Cabbage, Onion		
Coriander	all vegetables	Aphids	attracts Bees
Chervil	Radish		
Chives	Carrots	Root Flies	
Dill	Cabbage		Carrots and Caraway
Hyssop	Cabbage, Grapes	Cabbage White Butterflies	Dislikes Radishes
Marigolds	Good companion to most plants	Nematodes, Aphids and others	
Mint	Cabbage, Tomatoes	Cabbage White Butterflies, Aphids, Flea Beetles	invasive roots
Mustard	cabbage, cauliflower, radish, brussel sprouts, turnips, and kohlrabi	a trap crop to attract many insect pests	
Nasturtium	Radishes, Cabbage, Squashes and Pumpkins, fruit trees	Aphids, Squash Bugs, Striped Pumpkin Beetle	
	Brassicas	Cabbage Butterflies	
Pot Marigold	Tomatoes	Tomato Worm, Asparagus Beetles, Whitefly	
Rosemary	Cabbage, Beans, Carrots, Sage	Cabbage Butterflies, Bean Beetle, Carrot Fly	
Sage	Rosemary, Cabbage, Carrots	Cabbage Moth, Carrot Fly, Flea Beetle, Slugs	Dislikes Cucumbers
Southernwood	Cabbages	Cabbage Butterflies	
Summer Savory	Beans	Bean Beetles	

CROP	COMPANION PLANTS	INCOMPATIBLE WITH
Beans, Broad	Potato, Cucumber, Corn, Strawberry, Celery, Summer Savory	Onion
Beans, Runner	Corn, Summer Savory, Radish	Onion, Beets, Kohlrabi, Sunflower
Cabbage Family	Aromatic Herbs, Celery, Beetroot, Onion Family, Chamomile, Spinach, Chard	Dill, Strawberries, Runner Beans, Tomato
Cucumber	Beans, Corn, Pea, Sunflowers, Radish	Potato, Aromatic Herbs
Eggplant	Broad Beans, Marigold	
Lettuce	Carrot, Radish, Strawberry, Cucumber	
Melon	Maize, Nasturtium, Radish,	
Onion Family	Beetroot, Carrot, Lettuce, Cabbage Family	Beans, Peas
Potato	Beans, Corn, Cabbage Family, Marigolds, Horseradish	Pumpkin, Squash, Tomato, Cucumber, Sunflower
Radish	Pea, Nasturtium, Lettuce, Cucumber	Hyssop
Spinach	Strawberry, Cauliflower, Celery	
Squash	Nasturtium, Corn, Marigold	Potato
Tomato	Basil, Onion Family, Nasturtium, Marigold, Asparagus, Carrot, Parsley, Cucumber, Mint	Potato, Fennel, Cabbage Family

# Mechanical Controls

- Watering practices
- Staking and pruning
- Row covers
- Organic and plastic mulches
- Handpicking (e.g, inspect leaves, insects/eggs)
- Baits (e.g., beer in shallow sunken pan attracts slugs)
- Exclusion / Barriers
  - Cardboard or paper wrapped around plant stems prevent cutworm damage
  - Floating row covers to exclude insects
    - Cole crops, melons, squash
  - Wire cages reduce bird and rabbit feeding





# Biological Controls

- Predators, parasites, pathogens
- Natural predators in surroundings
- Learn to recognize beneficial insects
  - e.g., egg, larvae, and adult stage



Ladybug feeds on aphids

# Nematodes (Roundworms)

- A worm-shaped, animal; most are parasitic
- Nearly microscopic, invisible to the naked eye
- Feeds on organic matter, bacteria, insects, plants
- Nearly 15,000 soil-inhabiting species
- About 10% feed on plants, living around or in roots
- Root knot nematode is most well known
  - distinctive galls on infected roots
  - wide distribution
  - wide range of plants it attacks (most common vegetables, ornamentals, and fruit trees)
- Some nematodes are used as biological control agents of soil-dwelling pests



Okra



Tomatoes



- Above ground symptoms: stunting, yellowing, wilting, reduced yield, and premature death of plants.
- Below ground symptoms: swollen or knotted roots (root galls) or a stubby root system.
- Root galls vary in size and shape depending on the type of plant, nematode population levels, and species of root-knot nematode present in the soil.



**Root-knot nematode, *Meloidogyne* sp., infection on boxwood showing above ground symptoms (Lopez)**

# Brown Marmorated Stink Bug

- Piercing, sucking insect
- Remove weeds and crop residue
- Handpicking; vacuum
- Parasitic wasps
- Chemical control is difficult



# Aphids



- Many host plants
- Companion plantings to attract beneficial insects
- Water Sprays
- Beauveria bassiana
- Neem Oil
- Insecticidal soap



Parasitized Aphid

# Harlequin Bug

Greens, cole crops, lettuce,  
Handpicking  
Beauveria basiana  
Capsaicin & oil of Mustard  
Azadirachtin/pyrethrins  
Neem Oil  
Insecticidal soap



**Feed on mustard greens,  
cabbage, broccoli**

# Squash Bugs



Sanitation  
Rotation  
1 egg mass/plant threshold  
Chemical resistance  
Encourage beneficials

- Adults overwinter in crop debris
- Piercing sucking mps that transmit virus

Permethrin  
Kaolin clay  
Insecticidal soap  
Pyrethrins

# Colorado Potato Beetle



- Row Cover
- Clean cultivation
- Heavy mulching
- Plant near green beans, coriander, nasturtium
- Handpick and remove eggs
- Diatomaceous earth
- Permethrin
- Azadirachtin
- Canola/Pyrethrins
- Neem oil
- Spinosad



# Cabbage Looper

- A group of 3 caterpillars that feed on cole crops
- Adults lay eggs on underside of leaves
- Overwinter on trash of host plants
- Bt
- Beauveria bassiana
- Spinosad
- Insecticidal soap
- Many synthetic insecticides



# Cabbage Worm



- Row cover
- Garlic spray
- Bacillus thuringiensis, pyrethrins, spinosad, azadirachtin
- Diatomaceous Earth
- Plant near mint, sage, rosemary, hyssop

# Cutworm



**Bt**  
**Beneficials?**  
**Sanitation/weeds**  
**Tilling**  
**Compost NOT green manure**

Maintain dry earth barrier  
Water early and break up soil so that soil is dry at night  
Use 'dust mulching' when plants are young  
Use 2-3" plant collars of newspaper, foil, cardboard

# Wireworm



Live in soil for up to 6 years  
Damage roots and seeds  
No chemical control

Host: Carrots, cucurbits, onions,  
sweet corn, potatoes, beans and  
peas



**Adult stage – Click Beetle**

# Squash Vine Borer



Look in June/July  
Kaolin clay  
Permethrin  
Acetamiprid



# Cucumber Beetles



Carbaryl  
Permethrin  
Azadirachtin  
Kaolin clay  
Neem oil  
Pyrethrins  
Timing of planting?  
Netting/row covers

**6 Species**  
**Overwinter as adults**  
**Transmit bacterial wilt**  
**Leaves, roots, stems, fruit.**



# Flea Beetles



- Row covers
- Insecticidal soap or surfactant
- Plant late in season
- Lime, beauveria bassiana, diatomaceous earth, Neam/Azadirachtin, pyrethrins

1,2,3 generations per year

Overwinter as adults

Attracted to young plants by chemical cues

Trap crops: radish or daikon

# Tomato/Tobacco Horn Worm

- Can defoliate plant, voracious eater
- Usually see damage and frass first
- Moves thru 4-5 larval stages
- Parasitized by braconid wasp



Sphinx Moth







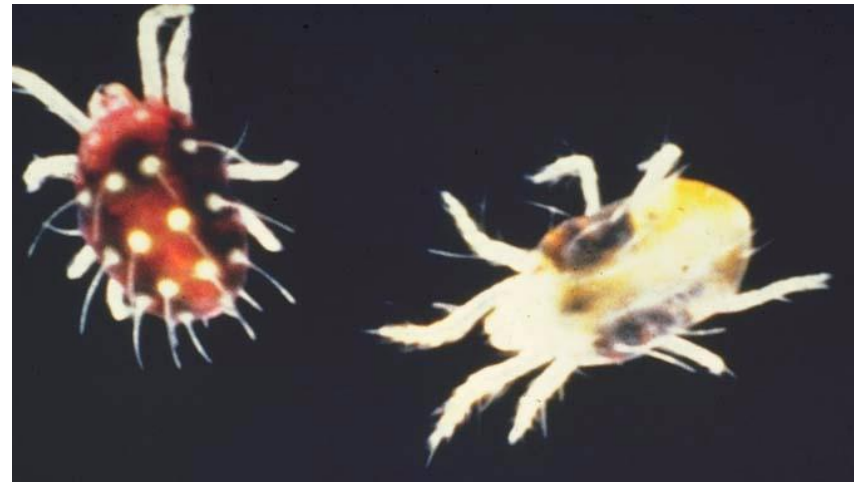
**whitefly adults**

# Whiteflies

- Small, white, usually on underside of leaves
- Piercing sucking mouthpart
- Sooty Mold
- Difficult to control
- Multiple generations
- Improve light and air circulation
- Encourage beneficials

Horticultural Oil  
Azadirachtin  
Canola oil  
Neem oil  
Insecticidal soap  
pyrethrins

# Mites



- Small, eight legs (not insects)
- Feeding damage causes stippling, or bleaching affect on foliage
- Population may collapse before damage is noticed
- Sulfur dusts or sprays, horticultural soap

# Resources

- Virginia Tech (VA Cooperative Extension)
  - Pest Management Guide (PMG)  
(<http://pubs.ext.vt.edu/456/456-018/456-018.html>)
- Rated for homeowner use
  - National Pesticide Information Center  
(<http://npic.orst.edu/>)
- 2014 PMG, Organic Insect Controls  
([http://pubs.ext.vt.edu/456/456-018/Section\\_2\\_Home\\_Vegetables-1.pdf](http://pubs.ext.vt.edu/456/456-018/Section_2_Home_Vegetables-1.pdf))
- Organic Materials Review Institute (OMRI)
  - OMRI Products List, Crop Fertilizers and Soil Amendments ([http://www.omri.org/sites/default/files/opl\\_pdf/crops\\_category.pdf](http://www.omri.org/sites/default/files/opl_pdf/crops_category.pdf))

# Need Help?

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