Common Disease and Insect Pests of the Vegetable Garden
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

<table>
<thead>
<tr>
<th>Vegetables Grouped by Family</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onions</td>
</tr>
<tr>
<td>Garlic</td>
</tr>
<tr>
<td>Leeks</td>
</tr>
<tr>
<td>Shallots</td>
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<tr>
<td>Chives</td>
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</tbody>
</table>
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
<table>
<thead>
<tr>
<th>INSECT PEST</th>
<th>REPPELLING PLANT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aphids</td>
<td>garlic, chives and other alliums, coriander, anise, nasturtium and petunia around fruit trees</td>
</tr>
<tr>
<td>Borer</td>
<td>garlic, onion, tansy</td>
</tr>
<tr>
<td>Cabbage moth</td>
<td>mint, hyssop, rosemary, southernwood, thyme, sage, wormwood, celery, catnip, nasturtium</td>
</tr>
<tr>
<td>Colorado potato beetle</td>
<td>green beans, horseradish, dead nettle, flax, catnip, coriander, tansy, nasturtium</td>
</tr>
<tr>
<td>Cucumber beetle</td>
<td>tansy, radish</td>
</tr>
<tr>
<td>Cutworm</td>
<td>tansy</td>
</tr>
<tr>
<td>Flea beetle</td>
<td>wormwood, mint, catnip, interplant cole crops with tomato</td>
</tr>
<tr>
<td>Japanese beetle</td>
<td>garlic, larkspur, tansy, rue, white geranium</td>
</tr>
<tr>
<td>Leafhopper</td>
<td>petunia, geranium</td>
</tr>
<tr>
<td>Mexican bean beetle</td>
<td>marigold, potato, rosemary, savory, petunia</td>
</tr>
<tr>
<td>Mites</td>
<td>onion, garlic, chives</td>
</tr>
<tr>
<td>Nematodes</td>
<td>marigold, salvia, dahlia, calendula, asparagus</td>
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<tr>
<td>Slug</td>
<td>prostrate rosemary, wormwood</td>
</tr>
<tr>
<td>Squash bug</td>
<td>tansy, nasturtium, catnip</td>
</tr>
<tr>
<td>Tomato hornworm</td>
<td>borage, marigold, opal basal</td>
</tr>
<tr>
<td>Whitefly</td>
<td>nasturtium, marigold</td>
</tr>
<tr>
<td>HERB</td>
<td>COMPANION FOR</td>
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<tr>
<td>----------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Allium</td>
<td>vegetables, fruit trees</td>
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<tr>
<td></td>
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</tr>
<tr>
<td>Basil</td>
<td>Tomatoes</td>
</tr>
<tr>
<td>Borage</td>
<td>Tomatoes, Squash, Strawberries</td>
</tr>
<tr>
<td>Catnip</td>
<td>Eggplant</td>
</tr>
<tr>
<td>Chamomile</td>
<td>Cabbage, Onion</td>
</tr>
<tr>
<td>Coriander</td>
<td>all vegetables</td>
</tr>
<tr>
<td>Chervil</td>
<td>Radish</td>
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<tr>
<td>Chives</td>
<td>Carrots</td>
</tr>
<tr>
<td>Dill</td>
<td>Cabbage</td>
</tr>
<tr>
<td>Hyssop</td>
<td>Cabbage, Grapes</td>
</tr>
<tr>
<td>Marigolds</td>
<td>Good companion to most plants</td>
</tr>
<tr>
<td>Mint</td>
<td>Cabbage, Tomatoes</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Mustard</td>
<td>cabbage, cauliflower, radish, brussel sprouts, turnips, and kohlrabi</td>
</tr>
<tr>
<td>Nasturtium</td>
<td>Radishes, Cabbage, Squashes and Pumpkins, fruit trees</td>
</tr>
<tr>
<td></td>
<td>Brassicas</td>
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<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Pot Marigold</td>
<td>Tomatoes</td>
</tr>
<tr>
<td>Rosemary</td>
<td>Cabbage, Beans, Carrots, Sage</td>
</tr>
<tr>
<td>Sage</td>
<td>Rosemary, Cabbage, Carrots</td>
</tr>
<tr>
<td>Southernwood</td>
<td>Cabbages</td>
</tr>
<tr>
<td>Summer Savory</td>
<td>Beans</td>
</tr>
<tr>
<td>CROP</td>
<td>COMPANION PLANTS</td>
</tr>
<tr>
<td>--------------------</td>
<td>----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Beans, Broad</td>
<td>Potato, Cucumber, Corn, Strawberry, Celery, Summer Savory</td>
</tr>
<tr>
<td>Beans, Runner</td>
<td>Corn, Summer Savory, Radish</td>
</tr>
<tr>
<td>Cabbage Family</td>
<td>Aromatic Herbs, Celery, Beetroots, Onion Family, Chamomile, Spinach, Chard</td>
</tr>
<tr>
<td>Cucumber</td>
<td>Beans, Corn, Pea, Sunflowers, Radish</td>
</tr>
<tr>
<td>Eggplant</td>
<td>Broad Beans, Marigold</td>
</tr>
<tr>
<td>Lettuce</td>
<td>Carrot, Radish, Strawberry, Cucumber</td>
</tr>
<tr>
<td>Melon</td>
<td>Maize, Nasturtium, Radish</td>
</tr>
<tr>
<td>Onion Family</td>
<td>Beetroots, Carrot, Lettuce, Cabbage Family</td>
</tr>
<tr>
<td>Potato</td>
<td>Beans, Corn, Cabbage Family, Marigolds, Horseradish</td>
</tr>
<tr>
<td>Radish</td>
<td>Pea, Nasturtium, Lettuce, Cucumber</td>
</tr>
<tr>
<td>Spinach</td>
<td>Strawberry, Cauliflower, Celery</td>
</tr>
<tr>
<td>Squash</td>
<td>Nasturtium, Corn, Marigold</td>
</tr>
<tr>
<td>Tomato</td>
<td>Basil, Onion Family, Nasturtium, Marigold, Asparagus, Carrot, Parsley, Cucumber, Mint</td>
</tr>
</tbody>
</table>
Mechanical Controls

• Watering practices
• Staking and pruning
• Row covers
• Organic and plastic mulches
• Handpicking (e.g., inspect leaves, insects/eggs)
• Baits (e.g., eer 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
• 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
Beauvaria 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

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

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

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
Squash Vine Borer

Look in June/July
Kaolin clay
Permethrin
Acetamiprid
Cucumber Beetles

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

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

- Row covers
- Insecticidal soap or surfactant
- Plant late in season
- Lime, beauvaria 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
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)

• 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)
Need Help?

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