College of Tropical Agriculture and Human Resources
University of Hawai'i at Mānoa

School Garden Basics Workshop For Educators

Insects, Diseases and IPM

by O'ahu Master Gardeners in cooperation with Kōkua Hawai'i Foundation

Objectives

- Identify types of insects and diseases
- Introduce IPM (Integrated Pest Management)
- Hands-on search and identification
- Provide resources for controlling pest and disease problems

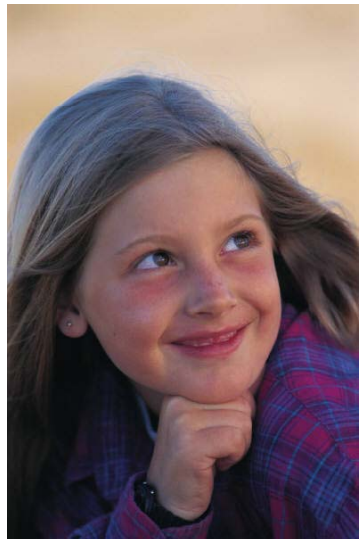
Common types of bugs

- Beneficials -good bugs

  - Lady Bugs, Lace Wings, Praying Mantis, Spiders

- Pests -bad bugs

  - Phloem sucking insects (Aphids, Mealy Bug, White Fly and Scale)
  - Piercing (Fruit Flies)
  - Chewing insects (Beetles, Grass Hoppers)
  - Ants
  - Mites, Corn Borers
  - Slugs/Snails



Typical Insect Life Cycles

- Complete metamorphosis
  - Egg>larvae>(pupa)>adult (bug, fly, moth) or
- Incomplete metamorphosis
  - Egg>nymph>adult
- Most lay plenty eggs
- Many pupate in the soil or under debris
- Control by breaking the cycle

Types of Pests

- Insects – think 6 legs with head, thorax, abdomen and exoskeleton (ants, mosquitoes)
- Arachnids – think 8 legs (spider, ticks, mites)
- Mollusks – think slugs and snails
- Animals – think birds and rodents, dogs and cats (and theft?)

Beneficials

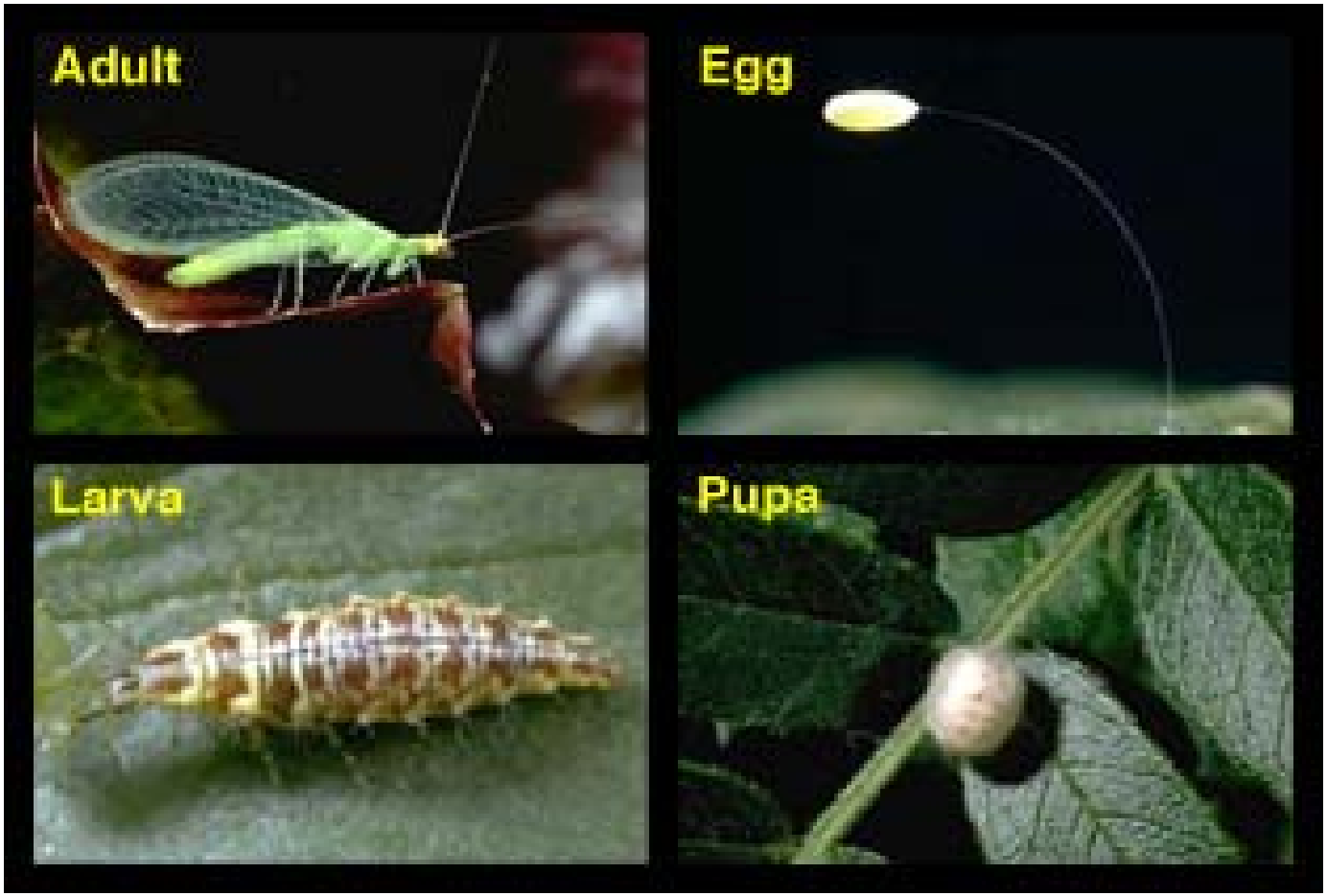
Lady Bugs –aka lady Beetles

eat aphid larvae – grow on fennel and dill

Beneficials and Aphids

- Wasps and aphids youtube - http://www.youtube.com/watch?v=rLtUk-W5Gpk
- Lady Bugs and aphids youtube - http://www.youtube.com/watch?v=zaDTlVwKgck&list=LPTyOyMk5PXL4&index=3&feature=plcp

Lace Wings



Preying Mantis

- Not common to Hawaii, but a good helper!

Spiders (are good!)

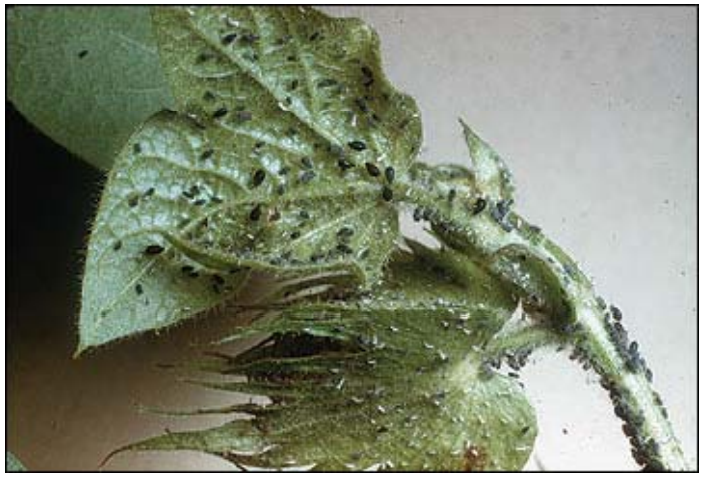
- Prey on many harmful insects, and usually very plentiful

Pests

Phloem Suckers/Piercing

- Aphids, Scale, White Fly, Mealy Bugs, Thrips
- Very common
- Easy to detect and control
- Carry many viruses and diseases (known as “vectors”)

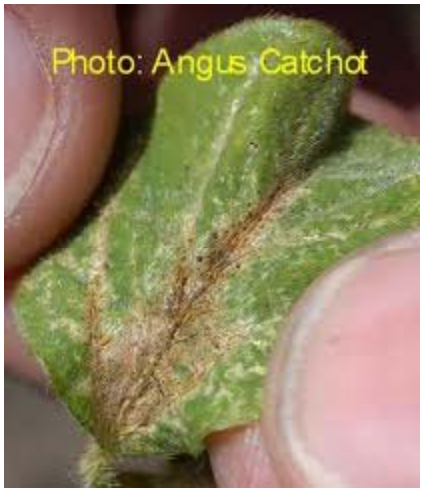
Aphids (can fly)



Scale

Mealy Bug

Thrips (can fly)



White Fly

Other Common Pests

- Mites, Beetles, Slugs, Leaf Miners, Corn Borers

Not Significant Pests

- Earwigs, Ants

Spider Mites

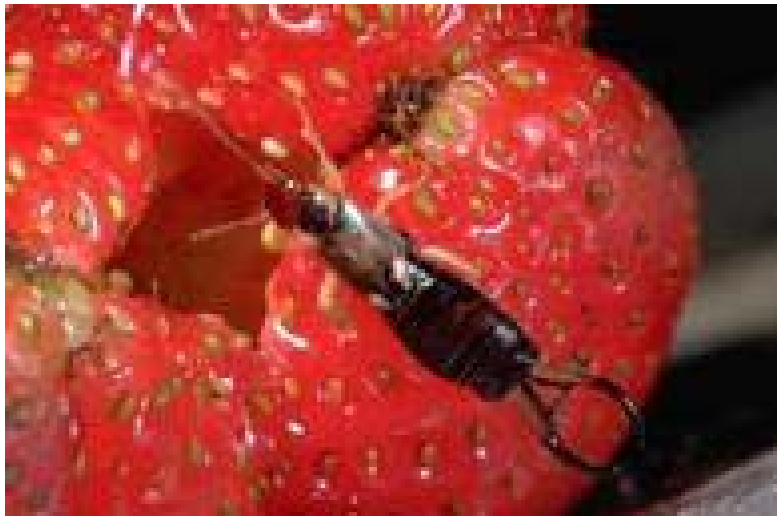
Beetles

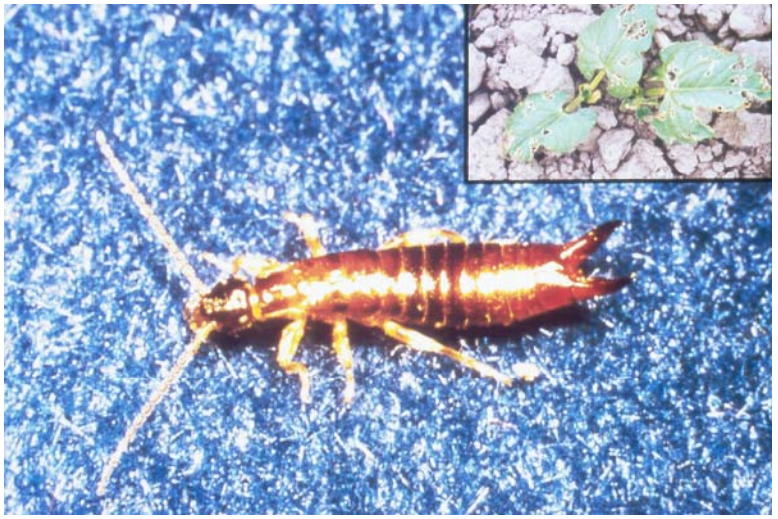
Slugs – Snails

Leaf Miner


UC Statewide IPM Project
© 2000 Regents, University of California

Earwig





Corn Borer

Dangerous Critters

- Centipedes
- Scorpions
- Fire Ants
- Bees
- Wasps
- Stinging Nettle Caterpillar
- Rat Lung Disease (slugs/snails)

Diseases

- Fungus
  - Good - yeast, mushrooms, decomposers
  - Harmful - powdery mildew, rust, sooty mold
- Viruses
- Root Rot

Yeast

Single-celled microorganisms that are classified, along with molds and mushrooms, as members of the kingdom *Fungi*.

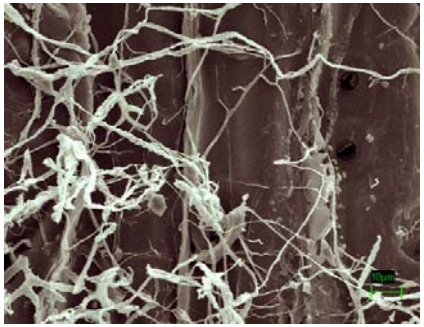
- Bread
- Beer, wine
- Ethanol

Mushrooms

- Can a fungus be delicious?

Decomposers

- Fungi are primary decomposers of wood and leaves - we wouldn't exist without them



Powdery Mildew (a fungus)

Rust (a fungus)

Sooty Mold (a fungus)

Virus (Latin for poison)

Banana Bunchy Top Virus

Other Common Problems

- Chlorosis
  - Yellowing of some of the leaves
  - Usually caused by over watering > nutrient deficiency
- Tip Burn and End Rot
  - Usually a watering problem –too little or too much
  - Result is calcium deficiency at end of leaf or fruit

Chlorosis

Tip Burn

Methods of Control

- Integrated Pest Management (IPM):

  "A sustainable approach to managing pests that combines biological, cultural, physical, and chemical tools in a way that minimizes economic, health, and environmental risks."

  (per UH)

IPM Plan (per UH)

- Prepare create the best growing conditions possible
- Identify/Monitor/Analyze....is it a ***significant*** problem?
- Methods of Control
  - Biological
  - Cultural
  - Mechanical/Physical
  - Genetic, Regulatory, and Chemical
    - Organic or synthetic- USE AS A LAST RESORT

      (If you kill the bad guys, you will also kill the good guys) ☹

Healthy Conditions

- Best cultivars?
- Watering techniques?
- Good lighting, drainage and air circulation?
- Nutrients/chemistry?
- Living soil (amended)?
- Do a smell and feel test – good earthy scent?
- Weeds?

Identify, Monitor, Analyze

- Shake out on paper
- Sticky paper/traps
- Baits (sugar, methyl eugenol, cue lures)
- Extrapolate what you find…..is it a *significant* problem?

Biological Controls

(living organisms)

- Beneficials (lady bugs – dill, fennel)
- Avoidance companions (marigolds, nasturtiums)
- Parasitic controls (wasps and certain flies)
- Insect pathogens (bacteria, fungi, viruses – all can sap strength and carry diseases)
  - Have fun with companion planting!

Companion Planting

- **Companion planting (aka interplanting) -** using different plant species in close proximity to enhance and support each other. Benefits include:
  - reduction in the numbers of plant pests
  - enhanced growth and flavor
  - attraction of beneficials
  - weed suppression

Companion Planting
includes/involves

- Pest distraction/confusion
- Symbiotic nitrogen fixation
- Biochemical pest suppression
- Physical spatial interactions
- Beneficial habitats
- Trap cropping

COMPANION PLANTING GUIDE

VEGETABLES	Name	Problems	Plant with	Don't plant with
	Beans, Pole (Poamoho)	Bean Fly	carrots, cucumbers, most herbs and vegetables	onions, garlic, gladiolus
	Cabbage (Mustard)	Cabbage Worm/ Rust	aromatic herbs, dill, onion,sage, rosemary, beets	tomatoes, pole beans
	Carrots (Nantes)	Early/late Blights	peas, lettuce,chives, onions, rosemary, sage,	dill
	Corn, Sweet (#9Yellow&#9Silver)	Mosaic Virus	pease, beans, cucumbers, pumpkin, squash	
	Cucumber (Lehau)	Pickle Worms	beans, corn, peas, radishes, sunflowers	potatoes, aromatic herbs
	Eggplant (Waimanalo Long)	Mites/Bacterial Wilt	beans	
	Kale (Dinosaur)	Cabbage Worms	aromatic herbs, dill, onion,sage, rosemary, beets	tomatoes, pole beans
	Lettuce (Manoa)	Slugs/snails	carrots, radishes (a strong team), strwberries,	
	Lettuce (Bambi)	Slugs/snails	carrots, radishes (a strong team), strwberries,	
	Onions, Green (Koba)	Thrips/aphids	beets, strawberries,tomato, lettuce,chamomile,	peas
	Pepper (Kaala)	Thrips/Pepper Maggot	tomatoes, petunias, geraniums	
	Potatoes, Sweet	Potato Weevil	beans, corn, cabbage, horseradish, marigold,	cucurbits, sunflower, tomato
	Radishes (Cherry Belle)	None	peas, nastrutium, lettuce, cucumber	
	Tomato, Grape (Komohana)	Fungal disease, fruit fly	chive, onion, parsley, marigold, nasturtiums,	potato, cabbage, fennel

HERBS	Name	Problems	Plant with	Don't plant with
	Basil (Sweet)	Downy Mildew	tomatoes to improve flavor	
	Dill	None	cabbage	carrots
	Lemon Grass	Rust		
	Rosemary	Spittle Bug	csabbage, beans, carrots, sage: deters cabbagge	

FRUITS	Name	Problems	Plant with	Don't plant with
	Avocado (Holiday & Wurtz)	Root & Stem Rot		
	Citrus, various	Citrus Scab/Black Fly		

NOTE: Many similar sources: Denver Urban Garden's School http://dug.org/storage/school-garden-curriculum/Companion_Planting_Guide.pdf

Companion Planting Notes

- Plant the “3 sisters” – used for centuries – corn, squash and beans
- Fennel is not friendly with any plants – plant outside your garden
- See chart in handouts
- Google “school gardens” and “companion planting”

Cultural Controls (i.e. cultivation)

- Sanitation – before, during, and after
- Tilling/plowing/compost/humus
- Crop rotation - crop timing - mixed cropping
- Trap cropping – crops planted to attract insects away
- Crop protection – wind, scraping, injury, staking, support
- Plant spacing
- Watering techniques
- Weed control
- Pruning and good tools (sharp clippers)

Mechanical/Physical Controls

- Water Spray
- Hand Picking/vacuum
- Barriers and applications:
  - Screens, netting, shade cloth, enclosures, traps
  - Temperature, water/flooding
  - Tables, copper tape

Genetic, Regulatory and Chemical Controls

- Genetic Controls:
  - Clean, fresh, certified seed –disease and pest resistant
  - Regulatory Controls – respect for restricting plant and pest movements and quarantines
- Chemical Controls – *LAST RESORT – Bad Guy/Good Guy*
  - Organic (OMRI certified) – soaps, Neem, oils, sulfur
  - Synthetic –follow the label – IT'S THE LAW!!!!!!

IPM Sequence Summary

Sequence Summary of IPM Gardening Techniques

Common Problem Areas/Symptoms	1st - Healthy Plant? > then	2nd Biological Controls >then	3rd Cultural Controls > then	4th Mech. Physical > then	Last Resorts
	watering, nutrients, soil weeds, seeds, light, drainage, air circ	beneficials, companions, distractions, soil, seed	sanitation, rotation, protection, spacing, weeds, pruning, mulch, tools	water spray, hand pick, barriers	
fruits/veggies/flowers/leaves					Organic Sprays
veggies/flowers					Sulphur
fruits/veggies/flowers/leaves					Hand Pick or Iron Phosphate
usually not a problem					Ant Bait
fruits/veggies/flowers/leaves					Organic Sprays
leaves					n/a
leaves					n/a
fruits/veggies/flowers/leaves	Dispose plant	Dispose plant	Dispose plant	Dispose plant	Dispose plant

Summary

- Bugs – beneficials and pests
- Diseases – good and harmful fungi
- IPM
- Companion planting
- *The Bottom Line*….
  - #1…… healthy plants, good cultivation
  - #2…… no drugs – kill good bugs with the bad bugs
  - #3……consider environmental impact

STEM Suggestions

- Tracking the sun to explain seasonal variations (23.5 deg)
- pH derivations and implications
- Determining how much and the type of water in soil
- Determining the spectrum of microbiology in soil…….and in the garden
- Pest estimations/evaluations
- Growth habitats in/out of sunlight – photosynthesis
- Soil color evaluation – what do the colors mean? Textures?
- Glass jar test with soil – kids bring soil from home

Handouts and References

- UH CTAHR free pubs (esp. IP-13 (2003): IPM for home gardens by Richard Ebisu
- UC Davis IPM
- Website www.ctahr.hawaii.edu/uhmg
- IPM matrix handout
- STEM and Companion Planting handouts
- TIP! : Google a topic and add “ext” or “edu”,

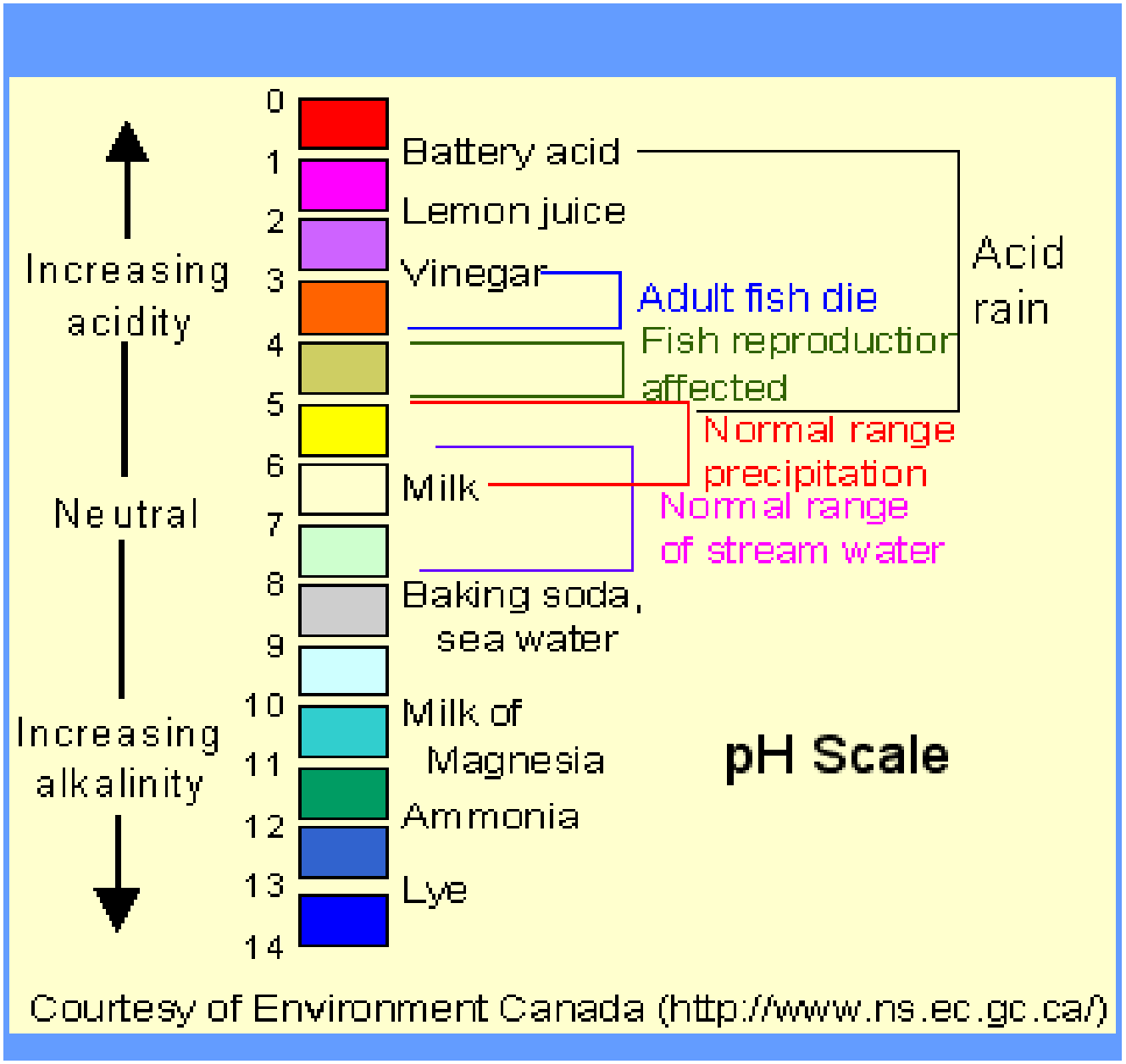
  ex: “aphids edu” or “aphids edu Hawaii”

LET’S GO OUT AND FIND SOME!

pH

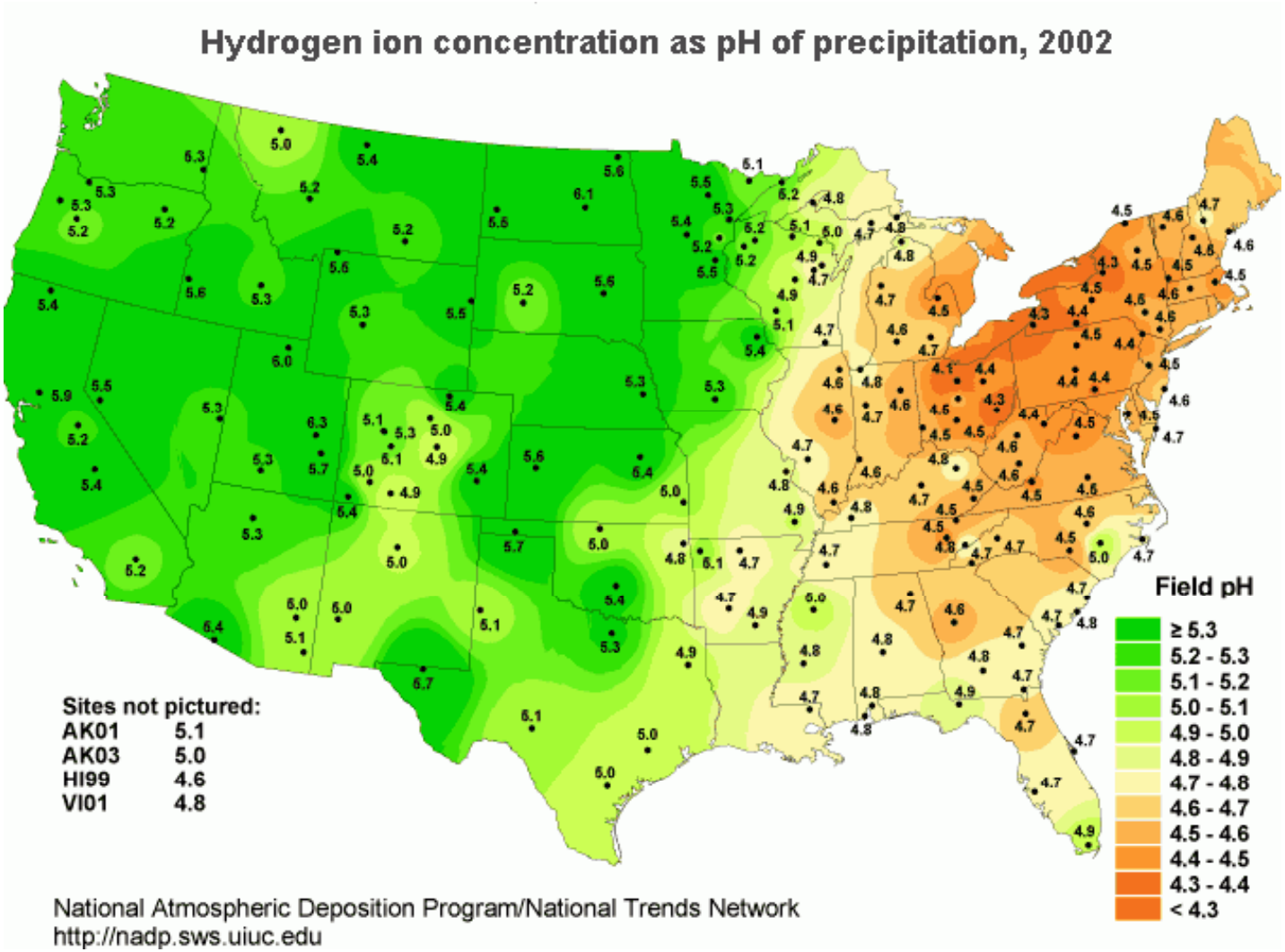
pH (the Power of Hydrogen)

- **BOTH H^+ and OH^- ions are ALWAYS PRESENT** in any solution. A solution is acidic if the H^+ are in excess. A solution is basic, if the OH^- ions are in excess
- **pH is defined as the negative logarithm of the hydrogen ion concentration.**


Increasing acidity
Neutral
Increasing alkalinity
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Battery acid
Lemon juice
Vinegar
Milk
Baking soda, sea water
Milk of Magnesia
Ammonia
Lye
Acid rain
Adult fish die
Fish reproduction affected
Normal range precipitation
Normal range of stream water
pH Scale
Courtesy of Environment Canada (http://www.ns.ec.gc.ca/)

Some pH examples

- Our stomach
- The ocean
- Your car
- Citric fruit
- Impacts on the microbial environment
- Acid rain


Hydrogen ion concentration as pH of precipitation, 2002
Field pH
≥ 5.3
5.2 - 5.3
5.1 - 5.2
5.0 - 5.1
4.9 - 5.0
4.8 - 4.9
4.7 - 4.8
4.6 - 4.7
4.5 - 4.6
4.4 - 4.5
4.3 - 4.4
< 4.3
Sites not pictured:
AK01 5.1
AK03 5.0
HI99 4.6
VI01 4.8
National Atmospheric Deposition Program/National Trends Network
http://nadp.sws.uiuc.edu

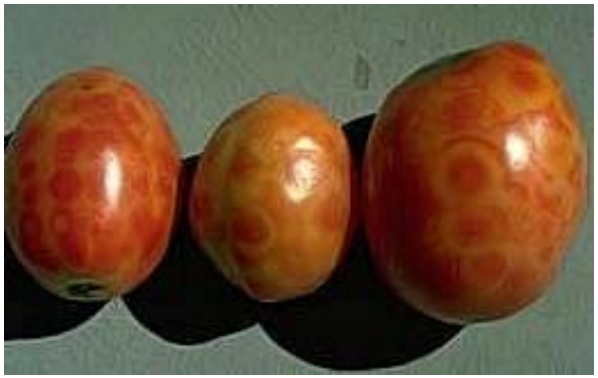
Stink Bug

Fruit Flies

Oriental
(fruit)

Melon
(vegetable)

Virus continued



Phytophthora and Fusarium Root Rot

(a water mold and a fungus)

Spittle Bugs

Summary Sequence of IPM Gardening Techniques

	Common Problem Areas/Symptoms	1st - Healthy Plant? > then	2nd Biological Controls >then	3rd Cultural Controls > then	4th Mech. Physical > then	Last Resorts
		watering, nutrients, soil weeds, seeds, light, drainage, air circ	beneficials, companions, distractions, soil, seed	sanitation, rotation, protection, spacing, weeds, pruning, mulch,	water spray, hand pick, barriers	
Pests						
Insects	fruits/veggies/flowers/leaves					Organic Sprays
Spider Mites	veggies/flowers					Sulphur
Slugs/Snails	fruits/veggies/flowers/leaves					Hand Pick
Ants	usually not a problem					Iron Phosphate ant bait
Diseases						
Fungus	fruits/veggies/flowers/leaves					Organic Sprays
Chlorosis	leaves					n/a
Tip Burn	leaves					n/a
Viruses	fruits/veggies/flowers/leaves	Dispose plant	Dispose plant	Dispose plant	Dispose plant	Dispose plant