UF/IFAS Extension
The Journey to Sustainability Begins with Education
Organic Vegetable Gardening
Pest Management
Robert Kluson
Ag/NR Extension Agent
UF/IFAS Sarasota County Extension
• Introduction to Organic Vegetable Gardening
• Soil Management
• Crop Management
• Pest Management
• Water Management
• Cover Crop & Compost Management
Approach of Presentation Series

• Promote the practice of the guidelines in the reference “Vegetable Gardening in Florida” by James M. Stephens. 1999. Univ. of FL, IFAS

• Provide background information on the science and principles from agroecology for successful organic vegetable gardening & community gardening

• Provide additional resources available for successful organic vegetable gardening
Introduction

- Goals of Presentation Series
  - Food for your freshest nutrition
  - Food for expanded community benefits
  - Food for thought
  - Food for your soul
Food for Soul

Only two percent of all insects are harmful. Why are they all in my garden? Dearly respect the lifestyle of worms. The spiders, grasshoppers, mantis, and moth larva are all back: the summer crowd has returned! Snail - Squash! Tomato Worm - Squash! Grasshopper - Squash! The Garden Trooper is at War!

- Michael P. Garofalo, Pulling Onions
Introduction

• Objectives of this presentation
  – Offer the concepts & principles from agroecology for pest management in organic vegetable gardening
  – Provide resources in the management of specific organic vegetable crop pests
Nature Model for Organic Vegetable Gardening

Three processes connect all the parts of the ecosystem:

- **Energy Flow** is the "power" of the system.
- **Water Cycling** and **Nutrient Cycling** are the movements of the elements and compounds that plants and animals need to live and grow.
Vegetable gardens can be managed as ‘agroecosystems’. Ecosystems have functional properties & subsystems (e.g., homeostasis, pests control, etc.) from biodiversity.
**Agroecosystem Property Example**

**“Hierarchical Scale”**

- **Ecosystem**
  - The farm in the context of its watershed

- **Community**
  - Polyculture of intercropped plants, along with other organisms

- **Population**
  - Monoculture of the crop plant

- **Organism**
  - Individual crop plant

> Monitor both inside & outside your garden area, as well as among same & different plants, for pests
Agroecosystem Property Example “Succession”

Early Stages

1. Bare soil
2. Annual monoculture
3. Annual polyculture
4. Polyculture of mixed annuals and short-lived perennials
5. Annual/perennial polyculture with tree seedlings
6. Agroforestry
7. Tree crop agroecosystem

Late Stages

Example Techniques: interplanting and rotational cropping

✓ Mimick natural ecosystems for enhanced stability.
Agroecosystem “Health”

• This concept addresses the failures and side-effects of agroecosystems based on:
  • focus on the well-being of separate subsystems (e.g., pests populations) rather than on their aggregated whole.

• Solutions are based on:
  • studying subsystems by considering their relations with the surroundings and other subsystems
  • defining health as capacities for regeneration & resiliency and not only resistance
Today’s Topic
- Vegetable Crop “Pests” -

• Categories
  – Weeds
  – Pathogens
    • Bacteria, fungi, virus, nematodes
    – Herbivores
      • Insects
What Is A Pest?

- A microbe, plant or animal that is out of place and/or timing according to crop production needs.
Definition varies from person to person

It is also very arbitrary and related to:

**Personal emotion (entomophobia)**
Measurable economic loss
Weeds

- Agroecosystem Benefits
  - Reduce soil erosion
  - Habitat for beneficials
  - Trap plant for pests

- Agroecosystem Costs
  - Yield reduction from resource competition
  - Habitat for other crop pests
### Table 11.2: Summary of interference interactions

<table>
<thead>
<tr>
<th>Type</th>
<th>Creator of interference (A)</th>
<th>Receiver(s) of interference (B)</th>
<th>Type &amp; identity of interference</th>
<th>Location of interference</th>
<th>Effect on A*</th>
<th>Effect on B*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Competition</td>
<td>Roles interchangeable</td>
<td>Roles interchangeable</td>
<td>Removal of resources</td>
<td>Shared habitat</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Parasitism</td>
<td>Parasite</td>
<td>Host</td>
<td>Removal of nutrients</td>
<td>Body of host</td>
<td>+</td>
<td>—</td>
</tr>
<tr>
<td>Herbivory</td>
<td>Herbivore</td>
<td>Consume (L)</td>
<td>Removal of biomass</td>
<td>Body of consumee; shared habitat</td>
<td>+ or –</td>
<td>– or +</td>
</tr>
<tr>
<td>Epiphytism</td>
<td>Host</td>
<td>Epiphyte</td>
<td>Addition of habitat surface</td>
<td>Body of host</td>
<td>0</td>
<td>+</td>
</tr>
<tr>
<td>Proto-</td>
<td>Roles interchangeable</td>
<td>Roles interchangeable</td>
<td>Addition of material or structure</td>
<td>Shared habitat or body of A/B</td>
<td>+ (0)</td>
<td>+ (0)</td>
</tr>
<tr>
<td>cooperation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mutualism</td>
<td>Roles interchangeable</td>
<td>Roles interchangeable</td>
<td>Addition of material or structure</td>
<td>Shared habitat or body of A/B</td>
<td>+ (–)</td>
<td>+ (–)</td>
</tr>
<tr>
<td>Allelopathy</td>
<td>Allelopathic plant plant</td>
<td>Potential habitat associates</td>
<td>Addition of active compound</td>
<td>Habitat of organism A</td>
<td>+ or 0</td>
<td>+, –, or 0</td>
</tr>
</tbody>
</table>

*Symbols in parentheses refer to effect when the organisms are not interacting.

- Plant-to-plant interactions include positive impacts.
Disease Pathogens

- Agroecosystem Benefits
  - Biocontrols of other pests
  - Decomposers
    - “Damping Off” fungi *Rhizoctonia solani* - usually a decomposer in healthy soil ecosystems
    - Nematodes – role in rhizosphere-based plant nutrition
      - Natural selection for crop adaptation
- Agroecosystem Costs
  - Loss of food yield & harvest
# Crop Disease Management

Table 1. Rotation periods to reduce vegetable soil-borne diseases (8).

<table>
<thead>
<tr>
<th>Vegetable</th>
<th>Disease</th>
<th>Years w/o susceptible crop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asparagus</td>
<td>Fusarium rot</td>
<td>8</td>
</tr>
<tr>
<td>Beans</td>
<td>Root rots</td>
<td>3–4</td>
</tr>
<tr>
<td>Cabbage</td>
<td>Clubrot</td>
<td>7</td>
</tr>
<tr>
<td>Cabbage</td>
<td>Blackleg</td>
<td>3–4</td>
</tr>
<tr>
<td>Cabbage</td>
<td>Black rot</td>
<td>2–3</td>
</tr>
<tr>
<td>Muskmelon</td>
<td>Fusarium wilt</td>
<td>5</td>
</tr>
<tr>
<td>Parsnip</td>
<td>Root canker</td>
<td>2</td>
</tr>
<tr>
<td>Peas</td>
<td>Root rots</td>
<td>3–4</td>
</tr>
<tr>
<td>Peas</td>
<td>Fusarium wilt</td>
<td>5</td>
</tr>
<tr>
<td>Pumpkin</td>
<td>Black rot</td>
<td>2</td>
</tr>
<tr>
<td>Radish</td>
<td>Clubrot</td>
<td>7</td>
</tr>
</tbody>
</table>
Crop Disease Management

Compost tea uses

- Foliar fertilizer
- Disease suppression
  - Foliar
  - Soil-borne
- Residue decomposition
- Enhanced soil biology
- Pest suppression

Steve Wright, Pennsylvania vineyard. Rodale Institute Photo.
What is Compost Tea?

- The liquid portion of compost soaked ("steeped") in water
  - Non-aerated
    - 1 part compost, 3-10 parts water
    - Occasional stirring
    - 1-3 weeks
  - Aerated
    - 1 part compost, 10-50 parts water
    - Air injection or constant circulation for 6-24 hours
    - Often made with additives (molasses, yeast extract, algal powder, kelp) to increase microbial biomass

http://organic.kysu.edu/CompostTea.pdf
Crop Disease Management

Goal is inoculation of beneficial, suppressive micro-organisms on leaf surface.
Crop Disease Management

NOP Compost Tea Task Force Recommendations

• Compost extract: Compost held in *potable* water for < 1 hr
• Compost tea: Compost held in water for > 1 hr
  – Aerated
    • 1 part compost, 10-50 parts water
    • Air injection or constant circulation for 12-24 hours
    • Often used additives (molasses, yeast extract, algal powder) to increase microbial biomass
  – Non-aerated
    • 1 part compost, 3-10 parts water
    • Occasional stirring
    • 1-3 weeks

Additives increase microbial biomass (both good and bad)
Crop Disease Management

NOP Compost Tea Task Force
Recommendations (April, 2004)

- Use drinkable water
- Sanitize equipment before use
- Use NOP-compliant compost (both plant and manure-based composts)
- No restriction:
  - Compost tea without additives
  - Compost extract (steeped for < 1 hr)
  - Compost tea with additives IF production system (compost + additives + equipment) makes tea that meets EPA water quality guidelines for E. coli and enterococci in two pre-tests
- 90/120 day pre-harvest restriction:
  - Untested compost tea with additives
  - Soil applications of raw manure extract/tea or compost leachate
- Prohibited:
  - Foliar applications of raw manure extract/tea or compost leachate
  - Use of compost teas for edible sprout production
Insect Herbivores

- Agroecosystem Benefits
  - Insects
    - Prey for pollinators
    - Part of food web
    - Decomposers of plant debris
    - Predators of other insects

- Agroecosystem Costs
  - Loss of food yield & harvest
  - Disease vectors of crops
Of all insect species in the world

Less than 1% Considered to be pests

Beneficial or not considered to be pests (> 99%)
Pest Management

Control vs. Elimination?
Pest Management Concepts

Example: Disease Occurrence

Conventional VS Agroecological
What is IPM? (Integrated Pest Management)

• An approach to managing pests by combining biological, cultural, physical and chemical tools in a way that minimizes economic, health and environmental risks.

• Developed in response to issues of synthetic pesticide usage:
  - pest resistance
  - environmental pollution
  - loss of biodiversity
  - human health impacts
Principles of IPM

1. Potentially harmful species will continue to exist at tolerable levels of abundance. Pests are an integral part of the ecosystem.
2. The ecosystem is the management unit
3. Use of natural controls is maximized
4. Use the most selective management tactic
5. Any control procedure may produce unexpected and undesirable consequences
6. An interdisciplinary systems approach is essential
Knowledge of Pests Biology
(and of the plant you are protecting)

When are they present?

Are all stages damaging?

Are some stages more susceptible?

Are there weaknesses?
Know your pests!!

Pests vs. Predators
**IPM Program**

- **Biology and Identification of Pests and Beneficials**
- **Economic Threshold (a prediction of loss vs. risk)**
- **Monitored Pest Populations**
- **Preventative Practices**
- **An Action Decision Must be Made**
- **Evaluation and Follow-up**
Pest Management

Requires

Some Detective Work

Disease?

Insects?

Nutrients?

Weeds?

Nematodes?

Water?

Other?
Diagnostic Resources

• Organic Production Pest Management Guidebooks
  – UF/IFAS Entomology Dept. Featured Creatures
    (http://entnemdept.ifas.ufl.edu/creatures/)
  – EDIS Vegetable Garden Insect Sheet
    (http://edis.ifas.ufl.edu/in006)
  – ATTRA Publications
    (http://attra.ncat.org/attra-pub/vegetable-guide.html)

• County Extension Offices (Diagnosis Services)
  – Master Gardener Help Desk
  – Plant Disease Clinic Network
    • Fee-based, plant sample services
    • 4 labs (Gainesville, Quincy, Immokolee, Homestead)
  – IPM specialists
The DDIS Process

1. Access the DDIS website
2. Send sample to a specialist
3. Online diagnosis by specialists
4. Report results to grower
5. Take a digital picture
6. Observe a disorder or pest
BioIntensive IPM

• Developed because the practice of IPM has strayed from its ecological roots!

• “Conventional” IPM has been implemented as “Integrated Pesticide Management” (or even “Improved Pesticide Marketing”)

• Conventional approach is missing guidelines for ecology-based manipulations of the agroecosystem that address the questions:
  – Why is the pest there?
  – How did it arrive?
  – Why doesn’t the parasite/predator complex control the pest?
“Farmscaping” is a whole-farm, ecological approach to pest management.

It can be defined as the use of hedgerows, insectary plants, cover crops, and water reservoirs to attract and support populations of beneficial organisms such as insects, bats, and birds of prey.

Applicable at the garden level too.

http://attra.ncat.org/attra-pub/farmscape.html
Farmscaping is “the modification of agricultural settings, including management of cover crops, field margins, hedgerows, windbreaks, and specific vegetation growing along roadsides, catchments, watercourses, and adjoining wildlands.” (Bugg et al 1998).

C. Shennan. Center for Agroecolgy & Sustainable Food Systems
Farmscaping Approach

• Provide successful habitat factors for desired beneficial organisms for all seasons:
  – Food
  – Cover
  – Water
  – Space
Agroecosystem Property Example

Agroecosystem as an Island

How about Island = Crop?

Tomato field A

Overwintering site

Tomato field B
<table>
<thead>
<tr>
<th>Predator Insect</th>
<th>What to Plant (Insectary Plant)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lacewings, aphidius, ladybugs</td>
<td>Achillea filipondulina</td>
</tr>
<tr>
<td>Hoverflies</td>
<td>Alyssum</td>
</tr>
<tr>
<td>Ground beetles</td>
<td>Amaranthus</td>
</tr>
<tr>
<td>Ichneumon wasp, ladybugs, lacewings</td>
<td>Anethum graveolens (dill)</td>
</tr>
<tr>
<td>Lacewings</td>
<td>Angelica gigas</td>
</tr>
<tr>
<td>Ladybugs, hoverflies</td>
<td>Convolvulus minor</td>
</tr>
<tr>
<td>Hoverflies, parasitic wasps, lacewings</td>
<td>Cosmos bipinnatus</td>
</tr>
<tr>
<td>Dicyphus</td>
<td>Digitalis</td>
</tr>
<tr>
<td>Lacewings, ladybugs, hoverflies</td>
<td>Daucus carola (Queen Anne's lace)</td>
</tr>
<tr>
<td>Damsel bugs, ladybugs, lacewings</td>
<td>Foeniculum vulgare (fennel)</td>
</tr>
<tr>
<td>Pirate bugs, beneficial mites</td>
<td>Helianthus annulus</td>
</tr>
<tr>
<td>Hoverflies</td>
<td>Iberis umbellata</td>
</tr>
<tr>
<td>Hoverflies, parasitic wasps</td>
<td>Limonium latifolium (Statice)</td>
</tr>
<tr>
<td>Aphidius, aphidoletes, hoverflies</td>
<td>Lupin</td>
</tr>
<tr>
<td>Parasitic wasps, tachinid flies</td>
<td>Melissa officinalis (lemon balm)</td>
</tr>
<tr>
<td>Parasitic wasps, hoverflies, tachinid flies</td>
<td>Petroselinum crispum (parsley)</td>
</tr>
<tr>
<td>Pirate bugs, beneficial mites</td>
<td>Shasta daisy</td>
</tr>
<tr>
<td>Pirate bugs, aphidius</td>
<td>Sunflowers</td>
</tr>
<tr>
<td>Ladybugs, lacewings</td>
<td>Tanacetum vulgare (tansy)</td>
</tr>
<tr>
<td>Dicyphus</td>
<td>Verbascom thaspas</td>
</tr>
</tbody>
</table>
Farmscaping
“State of the Art”

• Use a multiple redundant systems approach (e.g., “guilds" of food plants and natural enemies)
• Consider dispersion indices for insects foraging behavior
• Establish overwintering sites for beneficials
• Entrainment - some insects (especially parasitic wasps and flies) can perform associative learning (i.e., "tune in" to a particular pest when “happy” in their environment)
# Farmscaping

## “State of the Art”

<table>
<thead>
<tr>
<th>Pest/Life Stage</th>
<th>Egg</th>
<th>Larva 1</th>
<th>Larva2</th>
<th>Larva3</th>
<th>Larva4</th>
<th>Larva5</th>
<th>Pupa</th>
<th>Adult</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imp. Cabbage Worm</td>
<td>Ladybugs</td>
<td>Braconids</td>
<td>Same As</td>
<td>Assassin</td>
<td>Same As</td>
<td>Paper</td>
<td>Ptero</td>
<td>Dragonfly</td>
</tr>
<tr>
<td></td>
<td>Syrphids</td>
<td>Ladybugs</td>
<td>Larva 1</td>
<td>Bugs, Carabid Stink Bug</td>
<td>Larva 3</td>
<td>Wasps, Bugs, Carabid</td>
<td>Pupa, Bugs, Carab</td>
<td>Robber Fly</td>
</tr>
<tr>
<td></td>
<td>Lacewings</td>
<td>Syrphids</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trichogr.</td>
<td>Lacewing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Japanese Beetle</td>
<td>Carabids</td>
<td>Nematodes</td>
<td>Tipha, Nemas, Milky Spore</td>
<td>Tipha, Nemas, Milky Spore</td>
<td>No Such Stage</td>
<td>No Such Stage</td>
<td>None</td>
<td>Tachinid</td>
</tr>
<tr>
<td></td>
<td>Nematodes (Hb), Milky Spore</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

R.McDonald, Symbiont Biological Pest Management (www.drmcbug.com)
<table>
<thead>
<tr>
<th>Season</th>
<th>Plants for Insects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring</td>
<td>Mustards for Ladybugs &amp; Syrphid fly adults</td>
</tr>
<tr>
<td>Summer</td>
<td>Queen Anne’s Lace for Scoliid Wasps &amp; ladybugs</td>
</tr>
<tr>
<td>Fall</td>
<td>Fennel for Syrphid flies &amp; small parasitic wasps</td>
</tr>
<tr>
<td>Winter</td>
<td>Dandelion for Syrphid flies &amp; small parasitic wasps</td>
</tr>
</tbody>
</table>
Farmscaping Opportunity With Florida Native Plants

• Native plant/insect research shows high levels of insect interactions
• Florida native plants are known insectary plants
• Examples:
  – Butterfly plants
  – Coreopsis spp - syrphid flies, lady beetles, lacewings, and parasitic wasps
### Ecological Weed Management

- Understanding weeds and what things encourage them is the first step to controlling them without chemicals.
- Most weeds are “pioneer species” that respond to disturbances. So minimize disturbances.
- Put something else in the 'place' (companion plants, cover crops)
- Change the 'place' (soil balancing, mulching)
- Give the weed a 'place' (once it has a productive use, eg. an edible weed, it's not a 'weed' any more.)
**Plant Disease Concepts**

- **Hosts**
  - resistant vs tolerant to disease

- **Pathogens**
  - fungi, bacteria, viruses, mycoplasms, nematodes
  - specific vs generalist

- **Environment**
  - moisture, temperature, wind, sunlight, nutrition and soil quality

- **Human**
  - management, breeding
### A Strategy of Disease Control
- Resistant or Tolerant Varieties -

#### Codes Used to Designate Diseases and Related Problems

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALS</td>
<td>Angular Leaf Spot</td>
<td>LD</td>
<td>Late Blight</td>
</tr>
<tr>
<td>AN</td>
<td>Anthracnose</td>
<td>LR</td>
<td>Leaf Roll</td>
</tr>
<tr>
<td>ASC</td>
<td>Alternaria Stem Canker</td>
<td>MDMV</td>
<td>Maize Dwarf Mosaic Virus</td>
</tr>
<tr>
<td>BLS</td>
<td>Bacterial Leaf Spot</td>
<td>MMV</td>
<td>Mild Mosaic Virus</td>
</tr>
<tr>
<td>BLRV</td>
<td>Bean Leaf Roll Virus</td>
<td>NCLB</td>
<td>Northern Corn Leaf Blight</td>
</tr>
<tr>
<td>BR</td>
<td>Black Rot</td>
<td>NRKN</td>
<td>Northern Root Knot</td>
</tr>
<tr>
<td>BS</td>
<td>Black Speck</td>
<td></td>
<td>Nematode</td>
</tr>
<tr>
<td>BW</td>
<td>Bacterial Wilt</td>
<td>PM</td>
<td>Powdery Mildew</td>
</tr>
<tr>
<td>C</td>
<td>Cold Tolerance</td>
<td>PYY</td>
<td>Potato Virus Y</td>
</tr>
<tr>
<td>CBMV</td>
<td>Common Bean Mosaic Virus</td>
<td>R</td>
<td>Rust</td>
</tr>
<tr>
<td>CLS</td>
<td>Cercospora Leaf Spot</td>
<td>KMV</td>
<td>Kugose Mosaic Virus</td>
</tr>
<tr>
<td>CoMV</td>
<td>Cowpea Mosaic Virus</td>
<td>S</td>
<td>Smut</td>
</tr>
<tr>
<td>CMV</td>
<td>Cucumber Mosaic Virus</td>
<td>Sc</td>
<td>Scab</td>
</tr>
<tr>
<td>CR</td>
<td>Common Rust</td>
<td>SCLB</td>
<td>Southern Corn Leaf Blight</td>
</tr>
<tr>
<td>D</td>
<td>Drought Tolerance</td>
<td>SL</td>
<td>Speckle Leaf</td>
</tr>
<tr>
<td>DM</td>
<td>Downy Mildew</td>
<td>SR</td>
<td>Soil Rot</td>
</tr>
<tr>
<td>FB</td>
<td>Early Blight</td>
<td>SRKN</td>
<td>Southern Root Knot</td>
</tr>
<tr>
<td>F</td>
<td>Fusarium</td>
<td></td>
<td>Nematode</td>
</tr>
<tr>
<td>FY</td>
<td>Fusarium Yellows</td>
<td>SW</td>
<td>Stewart’s Wilt</td>
</tr>
<tr>
<td>GLS</td>
<td>Gray Leaf Spot</td>
<td>TB</td>
<td>Tip Burn</td>
</tr>
<tr>
<td></td>
<td>(Stemphylium)</td>
<td>TLS</td>
<td>Target Leaf Spot</td>
</tr>
<tr>
<td>H</td>
<td>Heat Tolerance</td>
<td>TMV</td>
<td>Tobacco Mosaic Virus</td>
</tr>
<tr>
<td>HC</td>
<td>Hard Core</td>
<td>V</td>
<td>Verticillium</td>
</tr>
</tbody>
</table>

- Refer to them in seed catalogs and crop breeding center research reports.
<table>
<thead>
<tr>
<th>Plant Disease Concepts</th>
</tr>
</thead>
</table>

- Resistance and/or tolerance for one disease in a variety is limited:
  - *does not necessarily transfer to other diseases*
  - *does not necessarily remain over time*
Conventional Plant Disease Breeding

- Conventional Programs
  - Trials not typically done on organic and diversified agroecosystems
  - “Minor crops” not covered
  - Costs and patent restrictions of commercial cultivars
  - Site specific conditions
  - ‘Vertical genetic resistance’ approach, i.e., gene for gene
‘Participatory Plant Breeding’ Program Option

• Raoul Robinson
  – “Return to Resistance” book
  – “Horizontal genetic resistance” approach, i.e., multi-gene based
  – Open-pollinated varieties-based
  – Equitable access-based
  – Workshops organized for “plant breeding clubs”

http://idl-bnc.idrc.ca/dspace/bitstream/10625/14258/18/102417.pdf
Horizontal Resistance

Definition

- It is possible to breed for horizontal resistance to any pest or disease, using only susceptible parents and by exposing new varieties to every available pest and disease in an organic growing environment.

- Horizontal resistance is durable resistance. It never breaks down to new strains of the pest or disease, as does vertical resistance. This means that the breeding is cumulative. A good cultivar need never be replaced, except with a better cultivar.
**Horizontal Resistance Breeding**

1) Grow seeds from a breeding pool with full exposure to pests and diseases, i.e., use susceptible cvs that produce seed to begin cross-pollination process.

2) Mix seeds back to the breeding pool, with everyone else’s results for the next generation.

3) Repeat selections for greater resistant cvs to get high levels of horizontal resistance – and every other desirable trait – which usually takes around six or seven generations to reach a maximum.
Participatory Plant Breeding Example Program

- **Organic Seed Partnership**
  - Originated from “Public Seed Initiative” Project
  - National trialing network
  - Farmers as breeders, selectors and evaluators
  - Supported by regional research centers in 6 states (not FL yet)
  - Germplasm originates from local small businesses
  - Marketed with partner small seed companies
Participatory Plant Breeding Example Program

• **Organic Seed Partnership**
  – Cornell University
  – Several small seed companies
  – Organic farmers

• **Results**
  – Since 2001, released 15 vegetable cvs
    • Squash, arrugula, potatoes, tomatoes, peppers
    • Example: Bush Delicata – powdery mildew resistant “sweet potato” squash (now sold by Johnny’s Select Seeds)
  – Is there any interest to participate from organic vegetable gardeners in Sarasota County?
What Are Nematodes?

- Unsegmented roundworms
- Aquatic
- Small
Root-knot Nematode Examples

Tomato

Okra
“Good”-vs-“Bad”

Nematodes

- Bacterial feeders
- Fungal feeders
- Predators

“Good guys”

- Animal-parasites
- Plant-parasites

“Bad guys”

✓ Most are beneficial, feeding on bacteria, fungi, or other microscopic organisms and some may be used as biological control organisms to help manage important insect pests.
1) Root tip & organic matter contact
   (OM)

2) Rhizosphere OM decomposition

3) Rhizosphere & predaceous protozoa and nematodes

4) Predator N wastes

5) Root uptake of N wastes
Nematode Management

- Adapted Cultivars
- Sanitation
- Organic Amendments, e.g., compost and chitin
- Crop Rotation
- Cover Crops
- Soil Solarization

http://edis.ifas.ufl.edu/ng005
Soil Solarization

- Determine the area to be sterilized and purchase clear plastic to cover it.
- Pull mature weeds and remove any plants; soil sterilization kills anything under the plastic, so do not use it near any plants you wish to keep.
- Remove rocks, roots and any other debris.
- Gently hoe or rake the soil.
- Moisten the soil with water or wait until a rain shower.
- Pull the plastic taut over the area to be sterilized.
- Dig a little trench around the perimeter of the plastic, and bury the edges to form a tight seal.
- Allow the sun's rays to bake through the plastic for at least four weeks.
- Check daily for holes in the plastic and check the edges. Both allow heat to escape. Fix holes and rebury the edges to recreate a tight seal.
- Remove plastic after at least four weeks have passed.

http://edis.ifas.ufl.edu/in824
UF/IFAS Resources

- EDIS – Online Publications on Vegetable Production & Diseases

- UF/IFAS Faculty – Gainsville campus
  - Plant Pathology Department
  - Horticultural Sciences Department
  - Entomology and Nematology Department
  - Center for Organic Agriculture

- UF/IFAS Extension & Research Faculty – county & REC vegetable specialists
UF/IFAS Online Newsletters

• “Vegetarian Newsletter”
  – A Vegetable Crops Extension Publication by UF Horticultural Sciences Department

• “Extension Berry/Vegetable Times”
  – By Gulf Coast Research and Education Center at Balm

• “South Florida Vegetable Pest and Disease Hotline”
  – By Hendry County Extension Office
  – Email alerts upon request
‘High Brix’ Gardening

**What Is It?**
- Management of the fundamental cause of crop pest damage
- Assumption: energy & mineral content determines the degree of health or disease of crops
- The instrument used to obtain a brix reading is the refractometer
- Goal: growth of high nutrient dense crops for human health
- Steps: increase soil humic/fulvic acids & soil life; provide mineral amendments, esp. trace ones

http://www.highbrixgardens.com/
In Summary

Manage Using All Available Strategies

- Use a least hazardous approach, that will also enact effective control
Cultural Practice Examples

Plant Selection: Companion planting

- **Pests and the Plants that Repel Them**

<table>
<thead>
<tr>
<th>Pest</th>
<th>Plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flea beetle</td>
<td>Catnip, marigold, nasturtium, peppermint, rue, spearmint, southernwood, tansy</td>
</tr>
<tr>
<td>Japanese beetle</td>
<td>Catnip, chives, garlic, nasturtium, odorless marigold, tansy, white geranium</td>
</tr>
<tr>
<td>Rabbit</td>
<td>Garlic, marigold, onion</td>
</tr>
<tr>
<td>Slugs and Snails</td>
<td>Fennel, garlic, rosemary</td>
</tr>
<tr>
<td>Spider mite</td>
<td>Coriander, dill</td>
</tr>
</tbody>
</table>

Cultural Control: Plant Maintenance

- Water for deep, spread roots
- Fertilizing
  - Too much fertilizer can increase insect pest problems as much as too little fertilizer.
- Mulching / Groundcovers
  - Can reduce weed problems
  - Avoid bringing new weeds to the garden in manure, straw
- Remove and properly dispose of garden debris

Physical Practice Examples

**Physical Control: Collars and Cages**

- Tin Collar
- Cutworm Control
- Plant Cage on Radishes
- Cabbage Maggot Control

**Physical Control: Row Covers**

- Covers many plants, or entire rows
- Protection for seedlings, or during other vulnerable times
- Light, thermal and air environment will be modified
Physical Practice Examples

**Handpicking**

Place insects in soapy water to kill them

**Water Sprays**

Spray plants with water to dislodge aphids.

Must be sprayed regularly to prevent recolonization.
Biological Practice Examples

Biological Control

- Biological control is the use of living organisms—parasites, predators, or pathogens—to maintain pest populations below economically damaging levels, and may be either natural (conservation) or applied (augmentative).

Insectary Plants for Biological Control

- Coreopsis, Parsnip,
- Mints
- Buckwheat
- Yarrow
- Sunflowers, Asters, Coneflowers
- Lobelia
- Goldenrod

The 3 P's: Predators, Parasitoids, Pathogens
Chemical Practice Examples
BioRational Pesticides

• Microbial origin
• Plant derived chemicals
• New pesticides, such as particle film barriers, pheromones, and compounds such as Spinosad, that have low non-target impacts and degrade into non-toxic components.

• Online resources:
  – Resource Guide Organic Insect and Disease Management (http://web.pppmb.cals.cornell.edu/resourcguide/)
Chemical Practice Examples
BioRational Pesticides

Chemical Control

- Although chemical control should be the last tactic considered, it may be the only way to quickly and effectively keep a particular pest in check.
- Used correctly, pesticides are indispensable tools of an IPM program.
- Incorrect use of pesticides can lead to:
  - pest resistance to the pesticide
  - outbreaks of secondary pests
  - adverse effects on nontarget organisms
  - direct hazards to the user

Minimizing the Negative Effects of Chemical Control

- Avoid applying pesticides on a windy day.
- Choose narrow over broad spectrum insecticides.
- Spot treat, rather than broadcast a pesticide.
- Always read the label, follow directions and do not apply more than is recommended.
- Wear protective clothing and eyewear.
- Dispose of unwanted pesticides and empty containers properly.

✓ Use as “last resort” & not first response! - including organic pesticides.
Organic Pest Management
Here’s why we are doing it.
Acknowledgements

• T. Weissling. Integrated Pest Management. UF/IFAS FT. Lauderdale REC

• R. Halman. A Discussion of Pesticides Environment and IPM Concepts Pesticide Safety for the Small Farmer. UF/IFAS Collier Co Extension

• R. DuFour. Biointensive IPM. ATTRA Publication