Organic Vegetable Gardening
*Beneficial Insects*

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Overview of topics of noontime talks on organic vegetable gardening

Introduction to organic vegetable gardening

Attracting beneficial insects: concepts and applications
<table>
<thead>
<tr>
<th>Topics of Noontime Talks for Organic Vegetable Gardening</th>
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<tr>
<td>• Introduction (Nov 23, 2011)</td>
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<td>• Edible Flowers (Dec 7, 2011)</td>
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<td>• Container Gardening (Dec 21, 2011)</td>
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<td>• Worm Composting (Jan 4, 2012)</td>
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<td>• Frost Protection (Jan 11, 2012)</td>
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<td>• Composting – Part 1 (Jan 25, 2012)</td>
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<td>• Transplants (Feb 8, 2012)</td>
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<td>Topics of Noontime Talks for Organic Vegetable Gardening</td>
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<tr>
<td>• Composting – Part 2 (Feb 22, 2012)</td>
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<td>• Irrigation (March 14, 2012)</td>
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<td>• Raising Honey Bees (March 28, 2012)</td>
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<td>• Companion Planting (April 11, 2012)</td>
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<td>• Cover Crops (April 25, 2012)</td>
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<tr>
<td>• Attracting Beneficial Insects (June 13, 2012)</td>
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<td>• Fruit Tree Gardening (June 27, 2012)</td>
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Goals for Noontime Talks on Organic Vegetable Gardening

– Food for your freshest nutrition
– Food for expanding benefits of backyard vegetable gardening
– Food for thought
– Food for your soul
### Approach of Noontime Talks on Organic Vegetable Gardening

- 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.

- Provide additional resources available for successful organic vegetable gardening.
• Available from UF/IFAS bookstore, see http://ifasbooks.ufl.edu/merchant2/
  Also available from your favorite book vender.
Agroecosystem Concept

• An approach that looks at your vegetable garden as a functional whole of interacting living and non living components, i.e. “whole is more than sum of parts”

• A science-based management using models from natural ecosystems

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.
• Garden agroecosystems have functional properties & subsystems from biodiversity management
Monitor both inside & outside your garden area, as well as among same & different plants, for beneficial & pest insects.
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*
What Is A Beneficial Insect?

- Any insect that controls harmful pests or pollinates plants. Beneficial insects include honey bees, native bees, ladybugs, and lacewing larvae.
What Is A Pest Insect?

- An insect 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)
## 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

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

Less than 1% Considered to be pests
**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
IPM Program

Evaluation and Follow-up

Biology and Identification of Pests and Beneficials

An Action Decision Must be Made

Preventative Practices

Monitored Pest Populations

Economic Threshold (a prediction of loss vs. risk)
Know your pests!!

Pests vs. Beneficials?
Bio-Intensive IPM

- Developed because the practice of IPM has strayed from its ecological roots!
- “Conventional” IPM said to be implemented as “Integrated Pesticide Management”
- 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?
Bio-Intensive IPM

- A system level, ecological approach to pest management.

- It can be defined as the use of hedgerows, insectary plants, cover crops, and water reservoirs to provide habitat for 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
Bio-Intensive IPM

- Successful habitats for desired beneficial insects have 4 requirements:
  - Food (e.g., insectary plants)
  - Cover (e.g., nests)
  - Water
  - Space
Providing Water
Providing Cover

- “Natural area” groupings of bare areas, ground cover, shrubs, and small trees

- Increase vertical height diversity

- Both food and cover can be provided at the same time
Providing Space

- Group flowers and other plants together to make large patches

- Allow sufficient area for different plantings to provide food throughout the year and a variety of flower types.

- Think about the landscape near your property
Providing Food: Insectary Plants

Characteristics

- Provide the protein (in pollen) and carbohydrates (in nectar) that beneficials need to thrive and produce more offspring.

- Available as supplemental food source when the pest insects they feed on are in short supply.
Insectary Plant Characteristics

- Commonly with small, shallow flowers suited for most beneficials that are minute in size, with shorter mouthparts.

- Examples - umbel-type plants (flower clusters shaped like flat-topped umbrellas) like those found in the carrot or Apiaceae family (dill, cilantro, etc.) and certain flowers found in the composite or Asteraceae family (daisy and chamomile).
Insectary Plant Characteristics

- Presence of extrafloral nectaries (nectar sources located outside the flower, e.g., the petiole or stem).

- A few examples include sunflowers, and legumes or Fabaceae family, e.g., lupines and vetch

<table>
<thead>
<tr>
<th>Predator Insect</th>
<th>What to Plant (Insectary Plant)</th>
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<tbody>
<tr>
<td>Lacewings, aphidius, ladybugs</td>
<td>Achillea filipendulina</td>
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<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>
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<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>Verbasceum thaspus</td>
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Bio-Intensive IPM
“State of the Art” Research

• Use a multiple redundant systems approach (e.g., “guilds” of food plants and beneficial insects)

• 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)
# Bio-Intensive IPM

**“State of the Art” Example**

<table>
<thead>
<tr>
<th>Pest/Life Stage</th>
<th>Egg</th>
<th>Larva 1</th>
<th>Larva 2</th>
<th>Larva 3</th>
<th>Larva 4</th>
<th>Larva 5</th>
<th>Pupa</th>
<th>Adult</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imp. Cabbage Worm</td>
<td>Ladybugs, Syrphids, Lacewings, Trichogr.</td>
<td>Braconids, Ladybugs, Syrphids, Lacewing</td>
<td>Same As Larva 1</td>
<td>Assassin Bugs, Carabid Stink Bug</td>
<td>Same As Larva 3</td>
<td>Paper Wasps, Bugs, Carabid</td>
<td>Ptero Pupa, Bugs, Carab</td>
<td>Dragonfly, Robber Fly, Spiders</td>
</tr>
<tr>
<td>Japanese Beetle</td>
<td>Carabids, Nematodes (Hb), Milky spore</td>
<td>Nematodes, 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>
<td></td>
</tr>
</tbody>
</table>
# Bio-Intensive IPM

## With Seasonal Insectary Plants

<table>
<thead>
<tr>
<th>Season</th>
<th>Plants for Insects</th>
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<tbody>
<tr>
<td><strong>Spring</strong></td>
<td>Mustards for Ladybugs &amp; Syrphid fly adults</td>
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<tr>
<td><strong>Summer</strong></td>
<td>Queen Anne’s Lace for Scoliid Wasps &amp; ladybugs</td>
</tr>
<tr>
<td><strong>Fall</strong></td>
<td>Fennel for Syrphid flies &amp; small parasitic wasps</td>
</tr>
<tr>
<td><strong>Winter</strong></td>
<td>Dandelion for Syrphid flies &amp; small parasitic wasps</td>
</tr>
</tbody>
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Insectary Plants
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
Native Bee Diversity

Sweat bee (Agapostemon spp)

Carpenter bee (Xylocopa spp)

Mason bee (Osmia spp)

Carder bee (Anthidium spp)

Bumble bee (Bombus spp)
Native Bee Background

- There are approximately 4,000 native bee species in North America
- In Florida there are 6 families and 360 genera of native bees
- Florida has a relatively large number of endemic species and subspecies
- Native bees are the most important pollinators of Florida native plants, although many other animals are also pollinators (e.g., butterflies, moths, beetle and birds)
How do bees pollinate flowers?

- Branched hairs and electrostatic forces help pollen stick to their bodies.
- Pollen is moved from male to female flowers parts, within or between different flowers through the same forces.
Native Bee Life Cycle

Complete Metamorphosis

1) Inside brood cell
   • Egg
   • Larvae 11 months
   • Pupae

2) Outside brood cell
   • Adult 6 weeks

Mining bee
Kinds of bees and their lifestyles

- **ground nesting bees**
  - bumble bees
  - miner/digger and long-horn bees
  - sweat bees
- **wood nesting bees**
  - carpenter bees
- **cavity nesting bees**
  - mason bees
  - leafcutter bees
  - yellow-faced bees
  - cleptoparasitic bees
- **honey bees**
Ground Nest Example

Polyester bee (*Colletes* spp)

Soil nest profile

- Entrance
- Tunnel
- Brood cells
Ground Nest Example

Bumble bees usually build jumbled nests of honey pots and brood cells in cavities in the ground or under clumps of grass. (Photograph by Edward S. Ross.)

Bombus citrinus
abdomen all black

Bombus fervidus
all but the last segment yellow
• Creating Wood/Cavity Nesting Cover

• Wood or tunnel nesting bees example

Bundle of paper straws

Wooden block with drilled holes
Providing nesting opportunities
Florida Species Example
Leaf Cutting Bees

In Florida there are 63 different species (plus five subspecies) within seven genera in the family Megachilidae (Ashmeadiella, Heriades, Hoplitis, Coelioxys, Lithurgus, Megachile, and Osmia)
Leaf Cutting Bee Pollinators

- Important native pollinators of many wildflowers

- Used as commercial pollinators (like honey bees) in fruits, vegetables and other crops such as alfalfa, onions, carrots, and blueberries, e.g. Osmia spp.

*Megachile* spp on alfalfa flower
Leaf Cutting Bee Biology

• Use 0.25 to 0.5 inch circular pieces of leaves they neatly cut from plants

• Construct cigar-shaped nests in cavities in soil, rotten wood, and plant stems

• Nests contain several cells, each containing stored pollen and a single egg

• Overwinter in these nests as newly formed adults
Leaf Cutting Bee Habitat Mgt

- Small diameter holes (size of a nickel or smaller) in soft, rotting wood are an ideal nesting site for these bees

- Some leafcutter bees will nest in thick-stemmed plants (such as roses and bamboo) with hollowed openings

*Megachile spp* entering a wood nest
Leaf Cutting Bee Ecology

• Can be considered a pest because of leaf cutting on ornamental plants, e.g., roses, azaleas, ash, redbud, bougainvillea and other plants with thin smooth leaves.

• Although the cutting can destroy the aesthetics, it rarely harms the plant.

• Prevent nesting by sealing pruned ends with wax or white glue.
Organic Insect 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