UF/IFAS Extension
The Journey to Sustainability Begins with Education

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Contemplative Food Gardening:

*SACRED COMMUNITY*

(ATTRACTING BENEFICIALS)

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OUTLINE

- Overview & Goals of Contemplative Food Gardening Presentation Series
- Short Review of Contemplative Food Gardens
- Growing Community
  - Your ecological community
  - Your contemplative community
• Introduction
• Feed Your Head (Edible Landscaping & Design)
• Growing Food When People & Place Matter (FL Climate, Crops and Soils)
• Ancient Traditions (Companion Planting and Biodynamic Agriculture)
• Sacred Community (Attracting Beneficials)
• Soil Food (Compost & Earthworms)
• Back to the Future (Contemplative Design & Container Gardening)
Goals for Talks on Contemplative Food Gardening

– Food for your freshest nutrition
– Food for thought
– Food for community benefits
– Food for your soul
Approach of Talks on Contemplative Food Gardening

• Integrate the concepts of contemplative gardens and edible landscaping, using organic food gardening practices

• Provide background information on the science and principles from agroecology for successful organic food gardening

• Offer an opportunity to participate in the setup of a contemplative food garden at Warm Mineral Springs Spa

• Provide additional educational resources
The thoughtful arrangement of edible plants in the landscape into a unified, functional biological whole to maximize their aesthetic appeal and food production.

**Treating Edibles as Ornamentals**
Review: What Is Organic Food Gardening?
Review: Organic Food Gardening

• It’s a science and art
• Incorporates the entire landscape design and environment, e.g., to improve and maximize the garden soil's structure, life & health
• Maximizes the production and health of developing food plants without using synthetic commercial fertilizers, pesticides, or fungicides

David Knauft, Horticulture Department, Univ. of GA
Review: Contemplative Food Gardening

Gardening outside the rows...creatively for personal inspiration and growth, as well as physical nourishment and growth
The outward spring and garden are a reflection of the inward garden . . .

. . . Cease looking for flowers there blooms a garden in your own home. While you go looking for trinkets, your treasure house awaits you in your own being . . .

Rumi
Sufi poet
1207-1273
Contemplative Garden Approach

- Discover your inward garden to grow your outward garden
- Your inward garden lies in your imagination, memory, character, & dreams
- Your outward garden lies upon your land – a private landscape for wandering, for dancing, for daydreaming

J.M. Messervy
Landscape Architect Visionary
Review: Contemplative Food Garden Design Approach

Turn your yard into a garden full of spaces of meaning and magic …

...“outdoor rooms” are created by taking advantage of sweeping curves and border plantings of flowering shrubs and trees.
Ecological Communities

- **Science of Agroecology**
- the application of ecological concepts & principles to the design & management of sustainable food production
- provides a framework based on the scientific study of the ecology of natural systems.
Ecosystem Model from Nature

ECOSYSTEM PROCESSES

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.

ILLUSTRATION: NICOLE BRAND
Garden agroecosystems have functional properties & subsystems from biodiversity management.
Agroecosystem Ecology
“Concept of Community”

Context of a Food Plant Community

For example, Insects
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.
**Predators** hunt, attack, and kill their prey. Encourage these natural enemies by avoiding pesticides that kill them, choosing plants that provide them pollen, nectar, and shelter, and keeping ants out of pest infested plants. Common predators that eat garden pests are pictured below.

- **Convergent lady beetles** prefer to eat aphids but sometimes eat whiteflies and other soft-bodied insects. Shown here are the adult (left), larva (center), and cluster of eggs (right).

- Green lacewing adults eat nectar and pollen. Some species also eat insects.
- Green lacewing larvae feed on mites, eggs, and small insects, especially aphids.
- Green lacewing eggs are laid on slender stalks in groups (as shown here) or individually.
- Predaceous ground beetle adults stalk soil-dwelling insects, such as cutworms and root maggots.
- Predaceous ground beetle larvae live on soil and in litter, feeding on almost any invertebrate.

- Assassin bugs attack almost any insect.
- Pirate bugs attack mites and any tiny insect, especially thrips.
- Damsel bugs are predaceous on a wide variety of small insects.
- Soldier beetle adults eat mostly aphids; their larvae are soil-dwelling.
- Spiders, including this crab spider, attack all types of insects.

- Syrphid fly (flower fly, hover fly) adults eat pollen and nectar.
- Syrphid fly larvae eat mostly aphids but also soft-bodied insects.
- Sixspotted thrips attack mostly mites.
- Western predatory mites attack pest mites.
- Some parasites attack insect eggs, such as the **Tissotus** species wasp.
- The blackish scale insects have wasp larvae developing within.

- Adults of predatory wasps, such as this paper wasp, prey on caterpillars and other insects.
- Praying mantids don't control pests, because they eat both beneficials and pests.
- Caterpillar parasites include the **Hypsober exiguus** wasp.

- Parasitized aphids die and turn into crusty "mummies" that can be black or beige. The hole in the mummy at left indicates a parasite has emerged. The aphid in the middle is healthy.

**Parasites** live and feed in or on a larger animal (host). Nearly all insect pests have at least one parasite that attacks them. Insects that parasitize other invertebrates (sometimes called parasitoids) are parasitic only in their immature stages and kill their host just as they reach maturity. Most insect parasites are host-specific wasps or flies, and many are so small that often you won't see them. An adult parasite can lay eggs in hundreds of host individuals with a resulting quick reduction in pest numbers.

**Beneficial Insect Examples**

What Is A Pest Insect?

• An insect that is out of place and/or timing according to crop production needs
Insect Herbivores Ecology Example

- **Agroecosystem Benefits**
  - Prey for pollinators
  - Components of food web
  - Decomposers of plant debris
  - Predators of other insects

- **Agroecosystem Costs**
  - Loss of food yield & harvest
  - Disease vectors of crops

- **Overall Agroecosystem Impact**
  - Balance of benefits vs costs
Of all insect species in the world, less than 1% are considered to be pests. More than 99% are beneficial or not considered to be pests.
Know How to Identify Pests vs Beneficials!!

Pests or Beneficials?
Cultural Traditions of Beneficial Insects

**SACRED BEES**

- Honey bees and honey are present in the creation myths, cosmologies and sacred places of many diverse ancient cultures.
- Honey bees were considered a symbol of the soul, of death and of rebirth.
- The hive of honey bees symbolized a functional society.
- Honey was regarded as a magical, sacred substance.
- Honey has had many uses:
  - foods and beverages
  - heal wounds and cure diseases
  - placed in tombs and used for embalming

http://beehaven.herokuapp.com/history-of-bee-worship
In the mythology of ancient Greece the Omphalos was the beehive or stone at the center of reality. It served as the portal to their gods.

Omphalos stones were erected in several areas surrounding the Mediterranean Sea; the most famous of those was at the oracle in Delphi.
Ancient bee goddesses included Aprodite, Artemis, Cybele, Demeter, Persephone, and Neith.

The ancient priestesses of the Bee Goddesses were known as the Melissaes in Greek and the Deborahs in Hebrew.

The Melissae represent the sacred feminine tradition.
SACRED BEES

- Bhramari Devi, the ancient Bee Goddess of India, (the “protector”)

“The queen bee is to her hive as a goddess is to her earthlings”

http://www.thebeegoddess.com/id38.html
Legend of Bhramari Devi, Bee Goddess

- **Bramari** signifies the 'Bees' in Hindi language.

- The central heart chakra is said to possess 12 petals and helps build the antibodies to protect humans from disease. Within this chakra resides Bhramari Devi and emits the droning notes of 'Bees' termed 'Bhramaran' as it throbs. It protects us from external attacks of negativities like bacteria or virus.
According to Hindu mythology, there once lived an asura (demon) called Arun. He wanted to establish his kingdom by driving out the devas (nature spirits) with his invading army.

The devas prayed to the deity Parmeshwari Devi to save them. She transformed herself into a large bee and with a swarm of bees which emerged out from her form surrounded the wives of the devas and sent out numerous lines of black bees, which joined with those emerging from her hands, covering the whole Earth.

The sky was completely overcast with the swarm of bees, and the Earth was cast into darkness and the spectacle presented a terrific sight. Then the black bees began to tear assunder the breasts of the demons, as bees sting those who disturb their hives.

The powerless asuras could not fight or communicate with one another, and so perished rapidly. Adi Shakti, in her form as the divine bee approached Aruna asura and said, "O, asura! Meet your end!" And she stung him to death.
The ancient Maya revered honey for its medicinal and ritualistic uses. Their pantheon of gods include a number of Bee gods, such as Ah-Muzen-Cab and Mok Chi, a multi faceted figure who is featured prominently in Mayan art and mythology. In the Yucatan, it is believed that the Ah-Mucen-Cab protects the locals from ‘Killer Bees’.

http://andrewgough.co.uk/bee2_2.html
Beeshed with small front boards over the gullet with different little pictures depicting Saints, people and animals and especially from everyday life.

Slovenian Melissae from long history of beekeeping.

http://www.thezaurus.com/gallery/112
Today there are contemporary artists & interpreters of some sacred practices and images of historical bee mythology.

For example, the frame drum was played by the Melissae. Their rituals and rhythms were drawn from their interaction with their bee hives. They serve as the inspiration of modern Melissae rituals.

See website of ‘Hymns from the Hive’ - http://www.layneredmond.com/Hymns_from_the_Hive.html
Importance of Pollinators

- More than 75% of flowering plants depend on animal pollinators
- In U.S., over 100 crop plants depend on animal pollinators (value >$15 Billion)
- Most natural ecosystems would collapse without animal pollinators
- Some plants are endangered because of diminished pollination
Fossil record that insect diversity increased dramatically following the origin of the flowering plants 100 M Yrs BP (in the Cretaceous period).
Why is pollination important?

- **Sexual reproduction** is important for evolution:
  - **Sexual reproduction produces variable offspring**, creating diversity and variation among populations (shuffling of genes)
  - You need variation for Natural Selection to occur
  - Sexual reproduction is advantageous to an organism only if it happens with someone other than itself!
  - Outbreeding = good! (inbreeding = bad…)}
Function of flower

• To attract pollinators with colorful petals, scent, nectar and pollen
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.

![Image of a bee and diagrams of pollination]
How bees make honey

Honeybees make honey from a sweet liquid called nectar, which they suck out of flowers. Older bees collect the nectar and pass it on to younger bees.

Passing on nectar

This picture shows how bees make honey inside their bodies.

The nectar goes down a tube to the bee's stomach, or honey sac.

In the honey sac, the nectar gets thicker and turns into honey.

The honey comes out through the bee's mouth. It is kept safe in the hive.
Benefits to the pollinators.

- **Benefits**
  - Pollen
    - rich food source
  - Nectar
    - average ~ 40% sugar
  - No benefit? - Trickery
    - pseudocopulation

Bee *Ophrys* – diagram from Charles Darwin

www.biol.wwu.edu/.../Coevolution/
### Pollination Impacts

- About 130 US crops are pollinated by bees

- List of crops that **benefit** but do not **require** bee visitation

  - Asparagus
  - Apricots
  - Broadbeans
  - Caraway
  - Cherimoya
  - Chestnut
  - Chives
  - Citrus
    - Grapefruit
    - Lemon
    - Mandarin
    - Orange
  - Clove
  - Clovers, minor
  - Coconut
  - Coffee
  - Cotton
  - Cowpeas
  - Cut flower seeds
  - Drug plants
  - Feijoa
  - Flax
  - Guava

  - Herbs (spices)
  - Kapok
  - Lespedeza
  - Lima beans
  - Loquat
  - Mangosteen
  - Nectarines
  - Oil palm
  - Okra
  - Onion and Leek
  - Opium poppy
  - Papaya
  - Pears
  - Peppers
  - Pyrethrum
  - Safflower
  - Scarlet runner beans
  - Strawberry
  - Tephrosia
  - Tomatoes
  - Vanilla
  - Vegetable seeds
    - Anise
    - Chervil
    - Endive

[Further information](http://gears.tucson.ars.ag.gov/beeclass/Pollination.pdf)
# Pollination Impacts

- List of crops that **require bee visitation**


<table>
<thead>
<tr>
<th>Crop</th>
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<tr>
<td>Alfalfa</td>
<td>Kohlrabi</td>
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<td>Almonds</td>
<td>Lavender</td>
<td>Vegetable seeds</td>
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<td>Alsike clover</td>
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<td>Blueberries</td>
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<td>Niger</td>
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<td>Chinese gooseberry or kiwi</td>
<td>Nutmeg</td>
<td>Tendergreens</td>
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<tr>
<td>Cicer milkvetch</td>
<td></td>
<td>Florets</td>
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</table>
Pollination Impacts

- List of crops that require bee visitation

Citron
Citrus
  Pummelo
  Tangelo
  Tangerine
Clovers, minor
Cranberries
Crimson clover
Crownvetch
Cucumbers
Currants
Cut flower seeds
Dewberry
Drug plants
Eggplants
Garlic
Gooseberries
Herbs (spices)
Huckleberry
Jujube
Kenaf

Parsnip
Passion fruit
Peaches & nectarines
Pears
Persimmon
Pimenta
Plums & prunes
Pumpkin & squash
Quinine
Radish
Rape
Raspberries
Red clover
Rutabagas
Sainfoin
Sapote
Sunflower
Sweetclovers
Sweetvetch
Tea
Trefoils
Dill
Fennel
Leek
Onion
Vetch (hairy)
Welsh onion
Watermelon
White clover
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, beetles and birds)
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

Bombus citrinus
abdomen all black

Bombus fervidus
all but the last segment yellow

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.)
Cavity Nest Example

- 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 Megachilideae (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
• 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
Biological Control of Pest Insects with Beneficial Insects

- Most pests have natural enemies (biological control agents) that regulate their population and are adapted to searching out & feeding on their host.
- Insect biological control agents exist as predators or parasites.
- Biological control is an important component of any integrated pest management (IPM) program.
Integrated Pest Management (IPM) “Bio-Intensive Approach”

• Developed because the practice of conventional IPM has strayed from its ecological roots!
• Conventional IPM criticized now as “Integrated Pesticide Management”
• Conventional IPM 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
“State of the Art” Research

• Use a systems level and multiple redundant approach (e.g., the use of offsite hedgerows to provide “habitat” and “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)

http://attra.ncat.org/attra-pub/farmscape.html
• 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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<td>Hoverflies</td>
<td>Alyssum</td>
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<td>Ground beetles</td>
<td>Amaranthus</td>
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<td>Ichneumon wasp, ladybugs, lacewings</td>
<td>Anethum graveolens (dill)</td>
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<td>Lacewings</td>
<td>Angelica gigas</td>
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<td>Ladybugs, hoverflies</td>
<td>Convolvulus minor</td>
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<td>Hoverflies, parasitic wasps, lacewings</td>
<td>Cosmos bipinnatus</td>
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<td>Dicyphus</td>
<td>Digitalis</td>
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<td>Lacewings, ladybugs, hoverflies</td>
<td>Daucus carota (Queen Anne's lace)</td>
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<td>Damsel bugs, ladybugs, lacewings</td>
<td>Foeniculum vulgare (fennel)</td>
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<td>Pirate bugs, beneficial mites</td>
<td>Helianthus annulus</td>
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<td>Hoverflies</td>
<td>Iberis umbellata</td>
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<td>Hoverflies, parasitic wasps</td>
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<td>Aphidius, aphidoletes, hoverflies</td>
<td>Lupin</td>
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<td>Parasitic wasps, tachinid flies</td>
<td>Melissa officinalis (lemon balm)</td>
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<td>Pirate bugs, beneficial mites</td>
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<td>Sunflowers</td>
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<tr>
<td>Ladybugs, lacewings</td>
<td>Tanacetum vulgare (tansy)</td>
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<tr>
<td>Dicyphus</td>
<td>Verbascum thapsus</td>
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Bio-Intensive IPM
With Seasonal Insectary Plants

- **Spring**
  - Mustards for Ladybugs & Syrphid fly adults

- **Summer**
  - Queen Anne’s Lace for Scolloid Wasps & ladybugs

- **Fall**
  - Fennel for Syrphid flies & small parasitic wasps

- **Winter**
  - Dandelion for Syrphid flies & small parasitic wasps
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
Nurture the child in you and rediscover awe for the world of beneficial insects in the garden.
Summary

• “Grow” a community of beneficial insects in your contemplative food garden

• Prepare your garden areas with the habitat for beneficial insects by providing
  - Food  - Water  - Cover  - Space

• The cultural & horticultural aspects of a community of beneficial insects offer you many contemplations in your garden
Resources


• Biodynamic Farming & Gardening Association - see https://www.biodynamics.com/


• Stevens, J.M. 2009. Organic Vegetable Gardening. UF/IFAS EDIS Publication #CIR375 – see http://edis.ifas.ufl.edu/vh019

• Stephens, J.M. et.al. 2010. Florida Vegetable Gardening Guide. UF/IFAS EDIS Publication #SP103 - see http://edis.ifas.ufl.edu/vh021