Sustainable Gardening

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Sustainability: The 3 E’s

• Ecological
  – Does it cause lasting damage to the biological systems on which it’s based?
• Economic
  – Can it be done profitably?
• Equitable
  – Is the system unjust to others?
• These are heady topics for a garden talk…
2009 east coast tomato and potato failure

- Late blight
  - *Phytophthora infestans*
  - Afflicts
    - Tomatoes
    - Potatoes
    - Others in Solanaceae

- In a well-managed farm:
  - Typically shows up late in the season
  - More of an annoyance than a problem
  - Organics: manageable
When it’s not so well managed …

- Poor quality control at one (?) big nursery
  - Thousands of infected tomato starts
  - Small gardens > farms
    - 36 million gardens 2008
    - >43 million as of Aug 2009
    - Not a lot of education
    - Pathogen can travel 40 mi
  - Early start to late blight
  - Impact on tomato and potato crops:
    - Conventional: barely manageable
    - Organic: crop loss
So what?

- Water
  - Quantity
  - Quality
- Soil
  - Quantity
  - Quality
- Air
  - Quality
- All connected
**Water Quantity:**

A limited resource

Landscape Water:
50-70% home use

- So Co population to increase 54% by 2050*
- Water use to outpace supply by 2020 **
- Conservation here to stay!
- Water ~ energy

* Sonoma County General Plan 2010
** Sonoma County Water Agency 2011
Water Need Through Irrigation Season

Water where?

- Hydrozone!
- Grouping plants with similar water needs
- Percentages are the proportion of reference Evapo-Transpiration (ETo)
- WUCOLS as a starting point:
  - [http://ucanr.edu/sites/WUCOLS/](http://ucanr.edu/sites/WUCOLS/)
Water Quality: The easy stuff

• Tap water
  – Under-appreciated?
    • Vs. bottled water
    • Used for irrigation
    • Hidden costs

• Well water
  – The wild west
    • Test it!
  – Dropping groundwater
    • Increasing costs
  – Ideal for irrigation?
  – Salt issues?
  – Potability?
  – Increased regulation

Image: info.forwater.com
Water Quality: The harder stuff

- **Recycled water**
  - (Grey water)
  - Salt issues?
  - Non-potable (?)

- **Harvested water**
  - Over-regulated?
  - Non-potable (?)
  - Low salt
  - Cost per gallon?

- **Issues**
  - Erosion
  - Other contaminants
• Mulch (no real definition)
• Minimize pesticide & herbicide use by using IPM practices
• Avoid over fertilization by soil testing to understand your garden’s specific needs
  • Determine needs and fertilize organically when you can!
• Keep water on your property (slow it, spread it, sink it!)
  • Integrate water catchment & reuse strategies
Avoid Over-fertilization

- Test soil – nutrient analysis
- Naturally derived fertilizers for slow release, e.g.:
  - Blood meal
  - Bone meal
  - Fish meal
Soil Quantity: Erosion

• Natural topsoil formation
  – 1 inch ~ 1000 years
  – Serpentine: longer

• Topsoil loss
  – Often unintentional
  – Sometimes unavoidable

• Topsoil building
  – Mulch
  – Compost
  – Cover cropping
  – Time & water
Soil Quality: Carbon

- Highly variable
  - Serpentine:
    - California’s state soil!
    - High Mg:Ca ratio
  - Clays get a bad rap
    - Much of the problem may be inherited from previous owners
    - “Abiotic”

- We can rebuild it
  - Parent material
  - Soil testing
  - Your own carbon sequestration project (air)
Nurture the Soil

- Know your soil type, pH, and its nutrient strengths and weaknesses
- Minimize erosion w/plants & mulch
- Consider alternatives to tilling
- Avoid soil compaction
- Compost on site (?)
- Utilize cover crops where appropriate
Low Input Gardening

• What might a garden look like if you didn’t add ANYTHING?
• Or maybe …
• Or maybe someone would be kind enough to landscape it for us
We’ve been bringing an awful lot of stuff into California
Invasion Rate is Increasing

\[ R^2 = 0.95, \ p < 0.0001 \]

Source: Daniel Gluesenkamp, CalFlora

Later data points: Fred Hrusa
Citrus leafminer

- Only attacks young leaves
- Winding tunnels with clear “film”
- Inconspicuous larvae
- Parasites are here
- More info:
  http://www.ipm.ucdavis.edu/PMG/r107303211.html
Polyphagous shot hole borer

- As far north as Ventura
- Kills many tree species
  - Coast live & black oak
  - Sycamore
  - Boxelder and maple
  - Cottonwood & willows
  - White alder
  - Wisteria and …
- Don’t move firewood
- Report suspected finds
- More info:
  - [http://ucanr.edu/sites/socaloakpests/Polyphagous_Shot_Hole_Borer/](http://ucanr.edu/sites/socaloakpests/Polyphagous_Shot_Hole_Borer/)
Asian Citrus Psyllid (ACP)

• Head down pose
• Curlycue wax filaments
• Carries Huanglongbing (HLB) disease
• HLB kills citrus
• ACP found recently in Pacifica / S. S.F.
• Report immediately
• More info:
  http://www.ipm.ucdavis.edu/PMG/C/D-CI-CAND-FF.001.html
Home, garden, turf, & landscape pests

University of California's official guidelines for managing pests with environmentally sound methods. (More...)

Search home & landscape:

Pests of homes and structures

- Household: pests of homes, structures, people and pets
  - Pests that sting, bite, or injure
  - Wood-destroying, food, fabric, and nuisance pests
  - Vermin: pests birds, mammals, and reptiles

Pests in gardens and landscapes

Choose a plant to find the most likely source of your pest problem

- Flowers
- Fruit trees, nuts, berries, and grapevines
- Lawns and turf, including comprehensive lawn guide
- Trees and shrubs, including roses and other ornamentals
- Vegetables and melons

Some common pests and methods

- Birds, mammals, and reptiles: vertebrate pests
<table>
<thead>
<tr>
<th>Plant Name</th>
<th>Scientific Name</th>
<th>Family Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metrosideros</td>
<td>Metrosideros spp.</td>
<td>Myrtaceae (Myrtle family)</td>
</tr>
<tr>
<td>Mexican blue palm</td>
<td>Brahea armata</td>
<td>Arecales (Palm family)</td>
</tr>
<tr>
<td>Mexican fan palm</td>
<td>Washingtonia robusta</td>
<td>Arecales (Palm family)</td>
</tr>
<tr>
<td>Mexican orange</td>
<td>Choisyta tamata</td>
<td>Rutaceae (Rut family)</td>
</tr>
<tr>
<td>Mmossa</td>
<td>Albizia spp.</td>
<td>Fabaceae (Pea family)</td>
</tr>
<tr>
<td>Mock orange</td>
<td>Choisyta tamata</td>
<td>Rutaceae (Rut family)</td>
</tr>
<tr>
<td>Monkey flower</td>
<td>Diplacus spp.</td>
<td>Scrophulariaceae (Figwort family)</td>
</tr>
<tr>
<td>Monkey flower</td>
<td>Mimulus spp.</td>
<td>Scrophulariaceae (Figwort family)</td>
</tr>
<tr>
<td>Monkey puzzle tree</td>
<td>Araucaria spp.</td>
<td>Araucariaceae (Araucaria family)</td>
</tr>
<tr>
<td>Mountain ash</td>
<td>Sorbus spp.</td>
<td>Rosaceae (Rose family)</td>
</tr>
<tr>
<td>Mountain mahogany</td>
<td>Gereccocarpus spp.</td>
<td>Rosaceae (Rose family)</td>
</tr>
<tr>
<td>Mugwort</td>
<td>Artemisia spp.</td>
<td>Asteraceae (Sunflower family)</td>
</tr>
<tr>
<td>Mulberry</td>
<td>Morus spp.</td>
<td>Moraceae (Mulberry family)</td>
</tr>
<tr>
<td>Mtcpgorum</td>
<td>Myoporum spp.</td>
<td>Myoporaceae (Myoporum family)</td>
</tr>
<tr>
<td>Myrtle</td>
<td>Melaleuca spp.</td>
<td>Myrtaceae (Myrtle family)</td>
</tr>
<tr>
<td>Nandina</td>
<td>Nandina domestica</td>
<td>Berberidaceae (Barberry family)</td>
</tr>
<tr>
<td>Natal plum</td>
<td>Carissa grandiflora</td>
<td>Apocynaceae (Dogbane family)</td>
</tr>
<tr>
<td>Natal plum</td>
<td>Carissa macrocarpa</td>
<td>Apocynaceae (Dogbane family)</td>
</tr>
<tr>
<td>New Zealand Christmas tree</td>
<td>Metrosideros spp.</td>
<td>Myrtaceae (Myrtle family)</td>
</tr>
<tr>
<td>Norfolk island pine</td>
<td>Araucaria spp.</td>
<td>Araucariaceae (Araucaria family)</td>
</tr>
<tr>
<td>Oak</td>
<td>Quercus spp.</td>
<td>Fagaceae (Beech family)</td>
</tr>
<tr>
<td>Oleander</td>
<td>Nerium oleander</td>
<td>Apocynaceae (Dogbane family)</td>
</tr>
<tr>
<td>Olive</td>
<td>Olea europaea</td>
<td>Oleaceae (Olive family)</td>
</tr>
<tr>
<td>Orchid tree</td>
<td>Bauhinia spp.</td>
<td>Fabaceae (Pea family)</td>
</tr>
<tr>
<td>Oregon grape</td>
<td>Mahonia spp.</td>
<td>Berberidaceae (Barberry family)</td>
</tr>
<tr>
<td>Oregon myrtle</td>
<td>Umbellularia californica</td>
<td>Lauraceae ( Laurel family)</td>
</tr>
<tr>
<td>Ornamental pear</td>
<td>Pyrus spp.</td>
<td>Rosaceae (Rose family)</td>
</tr>
<tr>
<td>Palm</td>
<td>Many species</td>
<td>Arecales (Palm family)</td>
</tr>
<tr>
<td>Palmetto palm</td>
<td>Sabal palmetto</td>
<td>Arecales (Palm family)</td>
</tr>
<tr>
<td>Polo verde</td>
<td>Cercidium spp.</td>
<td>Fabaceae (Pea family)</td>
</tr>
<tr>
<td>Paperbark</td>
<td>Melaleuca spp.</td>
<td>Myrtaceae (Myrtle family)</td>
</tr>
<tr>
<td>Pepper tree</td>
<td>Schinus mollre</td>
<td>Anacardiaceae (Sumac family)</td>
</tr>
<tr>
<td>Pepperwood</td>
<td>Umbellularia californica</td>
<td>Lauraceae (Laurel family)</td>
</tr>
<tr>
<td>Persimmon</td>
<td>Diospyros spp.</td>
<td>Ebenaceae (Ebon family)</td>
</tr>
<tr>
<td>Photinia</td>
<td>Photinia spp.</td>
<td>Rosaceae (Rose family)</td>
</tr>
<tr>
<td>Pindo palm</td>
<td>Butia capitata</td>
<td>Arecales (Palm family)</td>
</tr>
<tr>
<td>Pine</td>
<td>Pinus spp.</td>
<td>Pinaceae (Pine family)</td>
</tr>
<tr>
<td>Pittosporum</td>
<td>Pittosporum spp.</td>
<td>Pittosporaceae (Pittosporum family)</td>
</tr>
<tr>
<td>Podocarpus</td>
<td>Podocarpus spp.</td>
<td>Podocarpaceae (Podocarpus family)</td>
</tr>
<tr>
<td>Pomegranate</td>
<td>Punica granatum</td>
<td>Sapindaceae (Pomegranate family)</td>
</tr>
</tbody>
</table>
Oak—*Quercus* spp.
Family Fagaceae (Beech family)

**Plant identification**
Oaks are deciduous or evergreen trees with acorns.

**Optimum conditions for growth**
Oaks grow in various climatic zones and do well in full sun.

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**Leaves of valley oak**
© 1995 Br. Alfred Brousseau, Saint Mary's College of California

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**Invertebrates**

- **Acosm moth**
- **Aphids**
- **Armored scales**
  - Obscure scale
- **Bark beetles**
  - Ambrosia beetles
  - Oak bark beetles
- **Carpenterworm**
- **Clearwing moth borers**
  - Sycamore borer
- **Fibervorm, fiberv form, and acorn moth**
- **Flatheaded borers**
- **Flatheaded apple tree borer**
- **Goldspotted oak borer**
- **Oak twig girdler**
- **Pacific flatheaded borer**
- **Foliage-feeding caterpillars**
  - **California oakworm**
  - **Bruchus leafroller**
  - **Tent caterpillars**
  - **Tussock moths**
- **Folage miners**
  - **Leaf miners**
  - **Oak ribbed casemaker**
  - **Shield bearers**
  - **Skeletoizers**
- **Fulvous rose beetle and live oak weevil**
- **Gall and blister mites**
  - **Live oak arineum mite**
- **Gall makers**
  - **California gallfly**
  - **Cycad gall wasps**
  - **Ichneumonid wasps**
  - **Jumping oak gall wasp**
  - **Two horned oak gall wasp**
  - **Glassy-winged sharpshooter**
  - **Mealybugs**

**Invertebrates (cont.)**

- **Roundheaded borers**
  - **Roundheaded oak twig borer**
- **Soft scales**
  - **Kermes scales, black-punctured kermes**
  - **Oak lecanium scale**
- **Spider mites**
  - **Sycamore spider mite**
- **Treehoppers**
  - **Oak treehopper**
- **Whiteflies**
  - **Crown whitefly**
  - **Golden whitefly**
  - **Stanford whitefly**
  - **Woolly aphids**
  - **Woolly oak aphid**

**Diseases**

- **Anthracnose**
- **Ameloria root rot**
- **Canker diseases**
  - **Hypoxylon canker**
  - **Nectria canker**
- **Drippy oak acorns**
- **Foamy canker**
- **Oak branch dieback**
- **Oak leaf blistet**
- **Oak twig blight**
  - **Powdery mildew/Witches' broom**
- **Rusts**
- **Sudden oak death**
- **Wetwood**
- **Wood decay**

**Environmental disorders**

- **Leaf burn**
- **Leaf scorch**
- **Mineral deficiencies**
Powdery Mildew on Ornamentals

Powdery mildew is a common disease on many types of plants and is prevalent under the diverse conditions that cause disease on different plants. These fungi tend to infect either plants in the same family or only one species of plant.

IDENTIFICATION AND DAMAGE
You can recognize this disease by the white, powdery mycelial and spore growth that forms on leaf surfaces. This disease can be serious on woody species such as rose, crape myrtle, and peaches. New growth may be dwarfed, distorted, and covered with a white, powdery growth, healthy leaves.

LIFE CYCLE
All powdery mildew fungi require living plant tissue to grow. On perennial hosts such as roses, powdery mildew buds or as spherical fruiting bodies, called acarina, on the bark of branches and stems.

Most powdery mildew fungi grow as thin layers of mycelium on the surface of the affected plant parts. In many perennial hosts such as rose, powdery mildew buds or as spherical fruiting bodies, called acarina, on the bark of branches and stems.

WIND CARRIES Powedery Mildew spores to new hosts. Although relative humidity requirements for germination are high, wind action is very important in the spread of powdery mildew from one plant to another.

MANAGEMENT
The best method of control is prevention. Avoiding the most susceptible cultivars, placing plants in full sun in many situations. Some ornamentals do require protection with fungicide sprays if mildew conditions are favorable.

### Table 1. Host Plants and Control Measures for Powdery Mildew Species.

<table>
<thead>
<tr>
<th>Fungus species</th>
<th>Hosts</th>
<th>Control Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Golovinomyces cichoracearum</td>
<td>begonia, Composite family</td>
<td>Fungicide sprays</td>
</tr>
<tr>
<td>Erysiphe larsterreichiana</td>
<td>crape myrtle</td>
<td>Fungicide sprays</td>
</tr>
<tr>
<td>Sphaerotheca pannosa</td>
<td>rose</td>
<td>Fungicide sprays</td>
</tr>
</tbody>
</table>

### Table 2. Common Ornamentals Susceptible to Powdery Mildew.

<table>
<thead>
<tr>
<th>Fungus species</th>
<th>Hosts</th>
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<tbody>
<tr>
<td>aster</td>
<td>crape myrtle</td>
</tr>
<tr>
<td>azalea (deciduous)</td>
<td>dahlia</td>
</tr>
</tbody>
</table>

Los síntomas pueden variar de una especie a otra.

Los platos que requerían de tratamiento con menor frecuencia son los manzanos, zarzamora, albaricoque y uvas.

Controle las infecciones a moderadas de la cenicilla usando aceite de hortensia en jarrones de plantas o aceite de hortensia en jarrones de plantas de hortensia. No aplique demasiado aceite de hortensia, ya que puede ser una amenaza para algunos insectos beneficiosos.

Haga que las plantas menos susceptibles alteren el ambiente en que crecen.

### Table 3. Common Ornamentals Susceptible to Powdery Mildew.

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</tbody>
</table>

Reducez al mínimo el uso de productos que contengan productos químicos. Utilice alternativas no químicas o productos químicos menos tóxicos siempre que sea posible. Los estafadores de los productos químicos a menudo son informes sobre el uso del producto y el uso de productos químicos.

Pida más información sobre control de plagas a la Oficina de Extension Cooperativa de la Universidad de California que se encuentra en las páginas del gobierno del condado en el directorio telefónico o visite la página en la Red del Programa Integrado de Control de Plagas de la UC.

www.ipm.ucdavis.edu
UC IPM

- Environmental themes mentioned in management section
- Many other treatment options too
- Cultural and design options a good starting point
  - Especially if you can cure more than one problem

All powdery mildew fungi require living plant tissue to grow. On perennial hosts such as roses, powdery mildew survives from one season to the next as vegetative strands in buds or as asexual reproductive bodies, called chasmoconidia, on the bark of branches and stems.

Most powdery mildew fungi grow as thin layers of mycelium on the surface of the affected plant parts. Spores, which you can see with a hand lens, are part of the white, powdery appearance of the fungi and are produced in clusters on upper or lower leaf surfaces or on flowers, fruits, or herbaceous stems. In contrast, downy mildew, another fungal disease that produces visible powdery growth, has spores that grow on branched stalks and look like tiny trees. Also, downy mildew spores occur mostly on the lower leaf surface. Environmental conditions that favor the growth of downy mildew are different from those that favor powdery mildew and include low temperatures of 50°F to 70°F, a relative humidity of 90% or higher, and free moisture.

Wind carries powdery mildew spores to new hosts. Although relative humidity requirements for germination vary, all powdery mildew species can germinate and infect in the absence of free water. In fact, water on plant surfaces for extended periods inhibits germination and kills the spores of most powdery mildew fungi. Moderate temperatures of 60°F to 80°F and shade conditions generally are the most favorable for powdery mildew development. Powdery mildew spores and mycelium are sensitive to extreme heat and sunlight, and leaf temperatures above 95°F may kill the fungus.

MANAGEMENT

The best method of control is prevention. Avoiding the most susceptible cultivars, paving plants in full sun, and following good cultural practices will adequately control powdery mildew in many situations. Some ornamentals do require protection with fungicide sprays if mildew conditions are more favorable, especially susceptible varieties of rose and crape myrtle. (See Table 1.) For a list of other common ornamentals susceptible to powdery mildew, see Table 2.

### Table 1. Host Plants and Control Measures for Powdery Mildew Species.

<table>
<thead>
<tr>
<th>Fungus species</th>
<th>Hosts</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Golovinomyces cichoracearum</td>
<td>beinia, Composite family (chrysanthemum, daisy, philox, sunflower, and zinnia)</td>
<td>water</td>
</tr>
<tr>
<td>Erysiphe laegerstroemiae</td>
<td>crape myrtle</td>
<td>resistant</td>
</tr>
<tr>
<td>Sphaerotheca panacea</td>
<td>rose</td>
<td>resistant</td>
</tr>
</tbody>
</table>

### Table 2. Common Ornamentals Susceptible to Powdery Mildew.

<table>
<thead>
<tr>
<th>Susceptible Plant</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>aster</td>
<td>crase myrtle</td>
</tr>
<tr>
<td>azalea (deciduous)</td>
<td>dahia</td>
</tr>
<tr>
<td>begonia (tuberous)</td>
<td>deckinum</td>
</tr>
<tr>
<td>calendula</td>
<td>eucynmus</td>
</tr>
<tr>
<td>California poppy</td>
<td>forget-me-not</td>
</tr>
</tbody>
</table>
Know and help the good guys

- **Pollinators**
  - [https://anrcatalog.ucanr.edu/pdf/8518.pdf](https://anrcatalog.ucanr.edu/pdf/8518.pdf)

- **Predators**
- **Parasitoids**

- **Building better neighborhoods**
  - Food (& water?)
  - Shelter
  - Natives

Photo: UCCE Sonoma  Christine Casey?
The Four Basic Wildlife Needs:
Food, Water, Cover and Space
Cal IPC

- Don’t plant invasives
- California Invasive Plant Council
  - Don’t plant a pest
  - http://www.cal-ipc.org/
Other pests not to plant ...

• Soil pathogens
• Phytophthora species, e.g:
  – P. tentaculata
  – P. cactorum
  – P. cinnamomii
• Consider planting from seed
What about vegetables?

• Fruits and veggies aren’t drought tolerant
  – No water, no sugar, no biomass
• The water must be spent somewhere
• Edibles gardening *is* sustainable …
  – as long as it’s done right
    • (see previous slides)
  – and as long as you eat it
Right plant, right place

- The basic tenet to all good landscaping
- The right landscape plant shouldn’t need much
- Veggies in this climate will want water
Shade and Energy Conservation

• 40% of unwanted heat in your house comes in through windows.

• Use deciduous trees to the south & southwest to block sunlight before it enters the windows in the summer.

• In winter the trees drop their leaves and allow the sun to warm your home.
• Your small garden counts
  – One patch in a quilt
  – For better or worse

• The fewer inputs, the better, including:
  – Water
  – Fertilizers
  – Pesticides
  – And possibly even plant material
  – … but any wisdom carried to extreme becomes foolishness …

In the end, it’s all connected
Acknowledgements

• Karrie Reid, UCCE EH Advisor
• UC Sonoma Master Gardeners: http://ucanr.edu/sites/scmg/
• UC IPM: http://www.ipm.ucdavis.edu/
• Kathy Keatley Garvey: innumerable insect photos
• QWEL Program: http://www.qwel.net/
• WUCOLS: http://ucanr.edu/sites/WUCOLS/
• Cal IPC: http://www.cal-ipc.org/
• Native bunchgrass photo: http://nativeson.com/
• Drinking well water photo: http://info.forwater.com
Thanks!

- Presentation will be on-line at:
  - http://ucanr.edu/MarinIPM
- Steven Swain: 415 473 4226
  svswayne@ucanr.edu