Ecosystem and Plant Health Care with a Focus on Fall Season

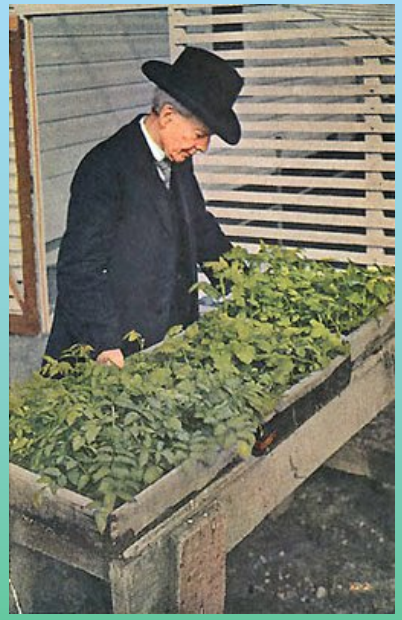
Linda J. Novy & Associates

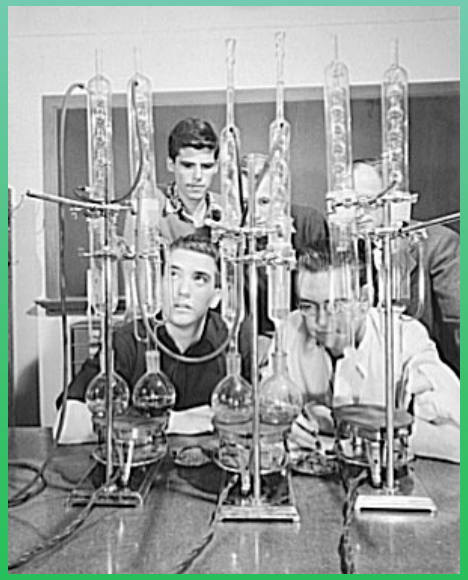
A Little Context…1953

Trends in Farming and Food Production

1800s	1900's to 1920's	1930's 1940's	1950's 1960's	1970's 1980's	1990's 2000	2014 and Future
1821Sulfur used as fungicide 1845 arthropod predators to control arthropod pests 1889 Australia ladybird beetle to control cottony-cushion scale	**First pesticide law enacted (to protect consumer)**	1935 US founded Soil Conservation Service 1938**Bacillus thuringiensis -** used as microbial insecticide **1942 2-4-D** and Huge range of synthesized pesticides introduced **1947 FIFRA** early pesticide regulation	The **Chemical Age Dawns** in Agriculture, Make "War" on the pests – DDT; Rampant water/air pollution **1959 Integrated control concept introduced for Agriculture**	Brundtland Commission of UN defines Sustainable Development **1972 FEPCA** **1970 US EPA formed; EPA cancels nearly all uses of DDT** **Endangered Species ACT**	**1990 Organic Foods Production Act**, National Organic Standards 1983 Early success with gene transfers (transgenetic)	Clarification of **Organic standards;** **EPA and Bay Friendly programs** promote Sustainable Practices **GMO** regulation Managed Ecosystems and Agro ecology **Mass bee kill in Washington – focus on pollinators**
Crop rotation, composting, manuring, liming, optimizing schedules of irrigation and drainage; plant breeding to develop resistant varieties	Small family Farming culture; horse drawn equipment Rudolf Steiner Biodynamic philosophy, WWI Limited commercial fertilizer, mostly bird guano, animal manures, bone meal; Seed saving, cover cropping, rotating crops	Overtilling, change to poor cultural practices, Drought, Dustbowl Exodus from farms World War II US. Post War industries transition to peacetime Postwar Fertilizer Explosion	Technological Explosion- sophisticated machines, "better pesticides," drought, Korean war	No-till farming regulations to manage pollution; green chemistry is born Reduction in chemical applications; Xeriscaping in California	Ecologically based Pest Management: holistic systems, classical IPM	**"Conservation" Tillage** promoted by US Soil Conservation Service **Soil Food Web Ecosystem services** Plant Health Care programs BMP's: water management, bio-pest management, storm water runoff, air quality, etc.
	George Washington Carver crop development and rotation	**Hometown Victory Gardens** produce up to 41% of all vegetables	**1962Rachel Carson, Silent Spring** **Alan Chadwick**, English Master Gardener, begins biodynamic farming at UC Santa Cruz ; **Rodale Press** promotes organic gardening	**Arne Naess** Deep Ecology movement	**Alice Waters**: Food to Table Michael Pollen: Food consciousness **Elaine Ingham**: soil food web and Rodale gardens **William McDonnough**, Green Chemistry, Waste = food	**Individual environmental stewardship through an eco-literate citizenry: YOU!** **Go baby!**

Significant Events in Farming

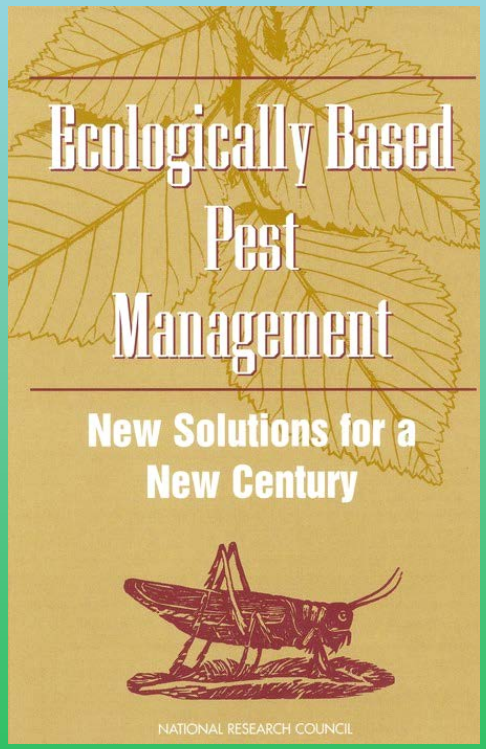




What Now?

What are the best ways to steward managed ecosystems?

- Understand that each agricultural, forest, or ornamental ecosystem "…consists of a dynamic web of relationships among crop plants or trees, herbivores, predators, disease organisms, weeds, etc."
- These systems are an ever-changing environment
- Goal: reduce not eliminate damage by pests
- Focus: enhancing the "inherent ecological strength of the system"
- External inputs "…would be added only if they add if they promote long term environmental health of soil biota, crops, and other organisms of the …systems"
  - Sourced: Ecologically Based Pest Management



New Goal for the Managed Landscape:"Plant Wellness"

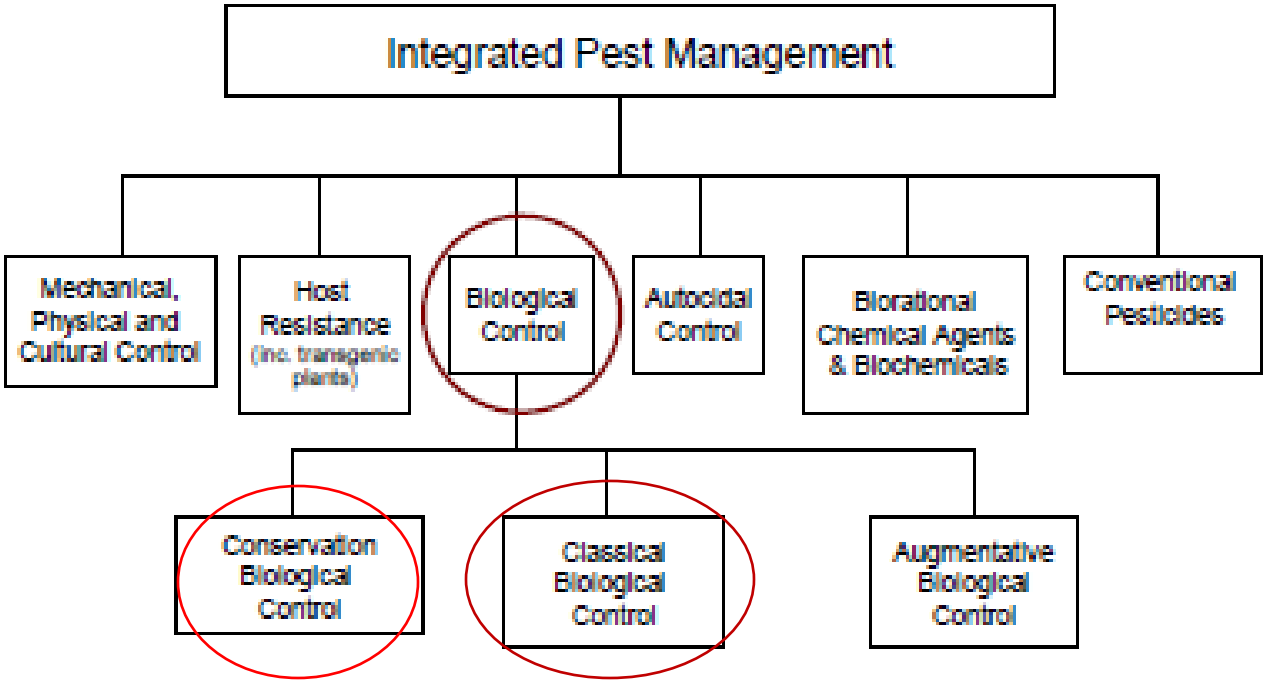
"IPM has been supplanted with plant health care; how do we make plants healthier versus controlling or managing a pest? Plant health care begins with the right plant in the right place, homeowner needs and tolerance levels, proper management, and a good IPM program."

Mike Greene, General Manager, Bartlett Tree Experts

San Rafael, CA

Plant Health Care and IPM

Integrated Pest Management



An Ecological Vision for Your Property

- What is <u>your</u> vision: To create an ecologically thriving garden/landscape?
- Translate <u>your</u> vision to the land:
  1. Determine the property's dominant plant community
  2. Retain native habitat and natural areas
  3. Conserve and increase floral resources
  4. Steward soil biota
  5. Apply appropriate irrigation

The Landscape Should Fit The Ecological "Frame" Of The Site

"There is a natural ecological framework for each landscape. Work within the native living communities: they are part of the natural succession of the landscape. Consider the soil, water budget, and cycles of life, growth, and rest. The more you deviate from the natural framework, the more issues you will need to manage. And…don't fuss with the soil. If you have the luxury to do so…then, GO SLOW."

- Dr. Fernando Agudelo-Silva Professor, Biology and Environmental Landscaping, College of Marin

1. Determine the Dominant Plant Community

Which one best represents your landscape?

- Mixed Evergreen Forest
- Oak Woodland and Oak Savannah
- Bishop Pine forest
- Coast Redwood Forest
- Grassland
- Coastal Beach-dune Vegetation
- Northern coastal Scrub
- Chaparral
- Coastal Salt Marsh
- Coastal Riparian Forest
- Freshwater Marsh

2. Retain Native Habitat: Every Patch Counts!

- Foraging, resting, mating habitat for many diverse organisms
- Attracts pollinators
- Conserves native soil organisms
- Encourages native plant succession
- Requires minimal to no maintenance inputs

3. Conserve And Increase Floral Resources = Conserve Biological Resources

How:

- Succession of blooms, diversity of flower colors and shapes
- Mostly native and portion non-native plants
- Nectar and pollen resources

Why:

- Boost Biodiversity
- Enhance natural pest control
- Attract and sustain predators and parasitoids, pollinators

4. Steward Soils and Keep Organic Matter On-site

- Healthy soil food web generates ecosystem services such as nutrient cycling, pest control, carbon sequestration
- Good soil structure retains water and promotes root growth – drought resiliency
- Improves overall plant health

Biological Assay

Foodweb Analysis
Soil

Report prepared for:
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Report Sent: 8/22/2011
Sample#: 01-112247 | Submission:01-021566
Unique ID: SFW #1
Plant: ornamentals
Invoice Number: 0
Sample Received: 8/4/2011

For interpretation of this report please contact:
Soil Foodweb Oregon
info@oregonfoodweb.com
(541) 752-5066

Consulting fees may apply

Organism Biomass Data	Dry Weight	Active Bacteria (µg/g)	Total Bacteria (µg/g)	Active Fungi (µg/g)	Total Fungi (µg/g)	Hyphal Diameter (µm)
Results	0.890	24.2	671	12.6	372	2.8
Comments	Above Range	Above range	Above range	Below range	In range	
Expected Range Low	0.45	5	20	40	100	
Expected Range High	0.85	15	250	65	500	

	Protozoa (Numbers/g)			Total Nematodes #/g	Mycorrhizal Colonization (%)	
	Flagellates	Amoebae	Ciliates		ENDO	ECTO
Results	5175	51752	65	3.57	Not Ordered	Not Ordered
Comments	Low	High	Good	Low		
Expected Range Low	10000	10000	50	20	40%	40%
Expected Range High			100	40	80%	80%

Organism Biomass Ratios	Total Fungi to Tot.Bacteria	Active to Total Fungi	Active to Total Bacteria	Active Fungi to Act.Bacteria	Plant Available N Supply (lbs/ac)	Actino Bacteria (µg/g)
Results	0.55	0.03	0.04	0.52	100-150	8.05
Comments	Low	Low	Low	Low		
Expected Range Low	2	0.1	0.1	0.75		
Expected Range High	5	0.15	0.15	1.5		

Nematode detail (# per gram or # per mL)
Classified by type and identified to genus.
(If section is blank, no nematodes identified.)

Bacterial Feeders	1.74	
Achromadora		0.08
Cephalobus		0.68
Monhystrella		0.47
Plectus		0.04
Prismatolaimus		0.17
Prodesmodora		0.13
Rhabditidae		0.13
Rhabdolaimus		0.04
Fungal Feeders	0.59	
Thonus		0.13
Tylencholaimus		0.47
Fungal/Root Feeders	0.81	
Aphelenchoides	Foliar nematode	0.25
Aphelenchus		0.04
Filenchus		0.51
Predatory	0.04	
Clarkus		0.04

5. Provide Appropriate Supplemental Irrigation

"Provide just enough water to keep natives hanging on and exotics from being stressed. Don't create overly moist conditions all the time – this leads to root rot. Most pathogens like warm and wet conditions."

-Steven Swain, Horticultural Advisor, Marin County, UC Extension – Marin and Sonoma Counties

Case Studies

Examples of landscape management approaches where:

- Plant community, native habitat, floral resources, soil management, irrigation, and a Plant Health Care program play important roles…

Case Study #1 Ornamental Landscape With Bee Hives, Surrounded By Open Space Lands

- Dominant Plant Community: Oak woodland savannah and chaparral
- Native Habitat retained: Baccharis, Quercus agrifolia, Eriogonum sp.
- Floral Resources: Introduced Oak woodland/chaparral natives, boosted meadow w/wildflowers (bee pasture)
- Soil Stewardship: soil testing, AACT, perscription fertilization, compost and change mulch
- Irrigation and water management: smart controller, Netafim, professional water manager, deep root water

Case Study #1 Plant Health Care and Integrated Pest Management

Plant type	Pests	Treatment action now	Future	Plant Health Care
Live Oak back of house	**Twig blight** (*Cryptocline)* Pit scale	Pageant, Pristine fungicide Hort oil for pit scale	Monitor	Monitor water needs; 1 – 2 x's pick off infected leaves, when rains, prescription organic fertilization; root collar clearing annually air spade
Heritage oak toward swing	Past: SOD	Don't treat unless twig blight observed	Monitor	Azomite application; root collar clearing
Smaller Oak adjacent to swing	Light twig blight	One app of Propiconazole fungicide	Shift to less/non toxic to bees	Infected leaves picked off 1 x Root collar clearing
Ceanothus	Defoliation	Analysis in lab	TBD	TBD
Arbutus unedo and marina	Canker? leafminer	Treat with Agrifos	Monitor	Prune one to ground leaving sprout; prune out other shrubs
Pyrus species Apple, Toyon	Fireblight	Treated with Badge – (Copper) (monitor for bee activity; cover other plants)	Monitor	Prune out infected; on-going pick leaves up off ground and dispose green waste bin; deep root feed (low N) w/biochar. Prune again in August when the bacteria are dormant.
Manzanita (location – near house	Thrips	Treat with Neem	Monitor	Clear root collars; remove horse hair mulch, and mulch w/chips
Redbuds (1)	Scale (variety TBD)	Treated with Astro (Permethrin), toxic to bees – change product to Neem	Monitor	Pruned out infected branches on one tree and other dead on remaining trees.

Disease In Oak;
Making A Bee Meadow

Case Study #2 Ornamental Landscape Surrounded By Open Space Lands

- Dominant Plant Community: Oak woodland Forest and Oak woodland savannah
- Native Habitat retained: One specimen Quercus lobata and a few native shrubs
- Floral Resources: minimal
- Soil Stewardship: Detrimental. Chemical fertilizer, no testing
- Irrigation and water management: DYI drip system, no management system
- Pest Management: Calendar spraying and injections with “big hammers”
- All landscape: Chemical fertilization 1x year, including Valley Oak
- Oaks and some shrubs: Fungicide spraying Cleary’s 3336 foliar spray and spray oil 2x annual
- Roses: 1x systemic insecticide Imidicloprid, 7x fungicide and insecticide; dormant 2x
- Fruit trees: Copper and Oil dormant spray

Case Study #2: Recommendations

- Point out negative feedback loop: boost nitrogen rich leaves, boost plant eating insect populations, need to treat, but then disrupt/kill beneficial insects
- Provide Bay Friendly Gardening handbook
- Recommend a true IPM program with monitoring, and OMRI certified products
- Recommend Plant Health Care program: compost, mulch, organic fertilizers
- Stop fertilizing the Oak
- Soil analysis and perscription fertilization
- Stop using Imidacloprid, a Neonicotinoid

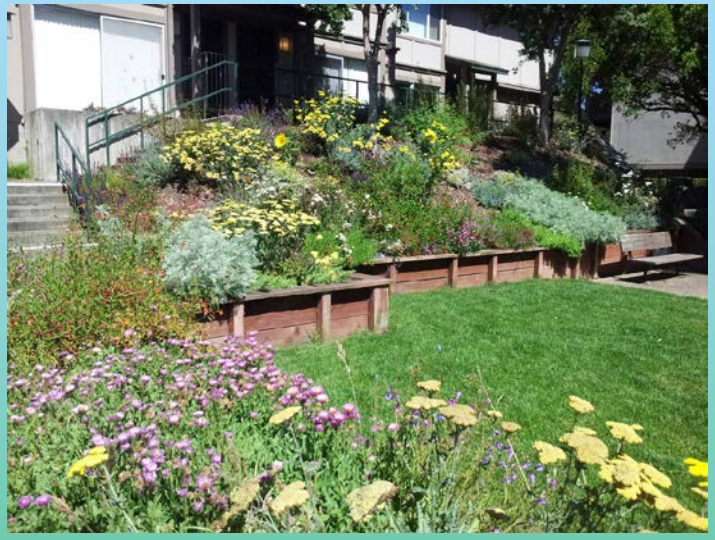
Case Study #3:
Ornamental Landscape Near Freeways

- **Dominant Plant Community**: San Bruno Mountain dunes, grasslands, fog influence
- **Native Habitat retained**: minimal; new landscaping boosting biodiversity, focus on endangered plant species
- **Floral Resources**: Sage communities, dense habitats and corridors
- **Soil Stewardship**: Was chemical, shift to organics based upon biological and chemical testing
- **Irrigation:** old and inefficient spray; brought in top water management company and transitioning to Netafim
- **Historical Pest Management**: Years of high N chemical fertilization, mites/thrips, black vine weevil not managed. Introduced monitoring and OMRI treatments provided by Arborist. Soil Plant Lab services analyze Maples

Case Study #3: Plant Health Care and Integrated Pest Management

Plant type	Pests	Treatment action	Future	Plant Health Care
Japanese Maples	Phoma (Soil Plant Lab tissue and soil analysis) Low soil nutrients, espc. N	Prune off diseased tissue	Monitor	Provide proper irrigation and plant nutrition
Rhododendrons	Mites	"Conserve" – key ingredient is Spinosad, a natural insecticide.	Monitor	Provide proper irrigation and plant nutrition
Woody shrubs, mostly Rhodies	Black vine weevil	Monitor, trap, nematode drench	Monitor	Chose weevil resistant Rhododendrons

Case Study #3



Case Study #4:
Ornamental and Native Landscape

- **Dominant Plant Community**: Coast Live Oak –California Bay-Madrone Forest; Coastal Riparian Forest
- **Native Habitat retained**: Significant valley oaks, bays, buckeyes;
- **New landscaping**: Deer resistant natives,encouraging plant succession (oaks, madrones, Baccharis, Stipa and Festuca)
- **Floral Resources**: Native hedges, riparian planting corridor, Baccharis, Sage, Rhamnus, Holodiscus, Symphoricarpus, and more
- **Soil Stewardship**: Transition from thistle to native meadow; Make hot compost and apply to all plants; re-mineralize soil; organic fertilizer to fruit trees and vegetable garden only.
- **Irrigation:** All drip, mostly Netafim transition, ET Water smart controller.

Case Study #4: :Plant Health Care and Integrated Pest Management:

Plant type	Pests	Treatment action	Future	Plant Health Care
Live Oaks	SOD	Agrifos 2x annually	Monitor	Clear root collars, apply compost & Azomite 1 x annually
Oregon Ash	1x Caterpillars	Conserve (Spinosad)	Monitor	Occasional water
Apple tree	1x Apricot Scale	Prune off most diseased; 1x Neem (Triac2, OMRI certified.)	Monitor	Deep root organic fert, every other year, drip irrigation, compost
Apple/pear	Codling Moth, Fungus	2x hort oil, Copper	Monitor; codling moth traps	Same as above; Clean up leaf litter after fall
Throughout	Weeds	Hand pull before seed	Monitor	Boost vegetative cover, mulch

Case Study #4

Case Study #5: Native and Ornamental Landscape

- **Dominant Plant Community**: Oak Savannah
- **Native Habitat retained**: Some Valley and Live Oaks, Buckeyes; Toyons, Baccharis sp., Salix sp.
- **New landscaping**: Transition lawns to native plants
- **Floral Resources**: Native hedges, riparian planting corridor, reduced hedging to allow bloom, perennials
- **Soil Stewardship**: Soil testing, mycorrhizae and biochar to new planting, compost
- **Irrigation:** spray - lawns and Netafim - beds; reclaimed water, smart controller

Case Study #5: Plant Health Care and Pest Management:

Plant type	Pests	Treatment action	Future	Plant Health Care
Live Oaks	SOD	Agrifos 2x annually	Monitor	Clear root collars, apply compost & Azomite
Hawthorne trees	Ambrosia beetles	Remove all trees	Monitor	Replaced with Cercis, more resistant, and improved irrigation
Sycamore Trees	Anthracnose	Cultural actions due to parking lot	Monitor	Deep root water, irrigate, mulch
Live Oaks	White Fly	Allow natural predators	Monitor	Live Oaks
Lawns	Kikuyu Grass	Pull, spray; clean mow equipment	Eliminate lawns, treat Kikuyu w/herbicide	Maintain 2 remaining turf areas organically

Case Study #5

Key Actions: Fall

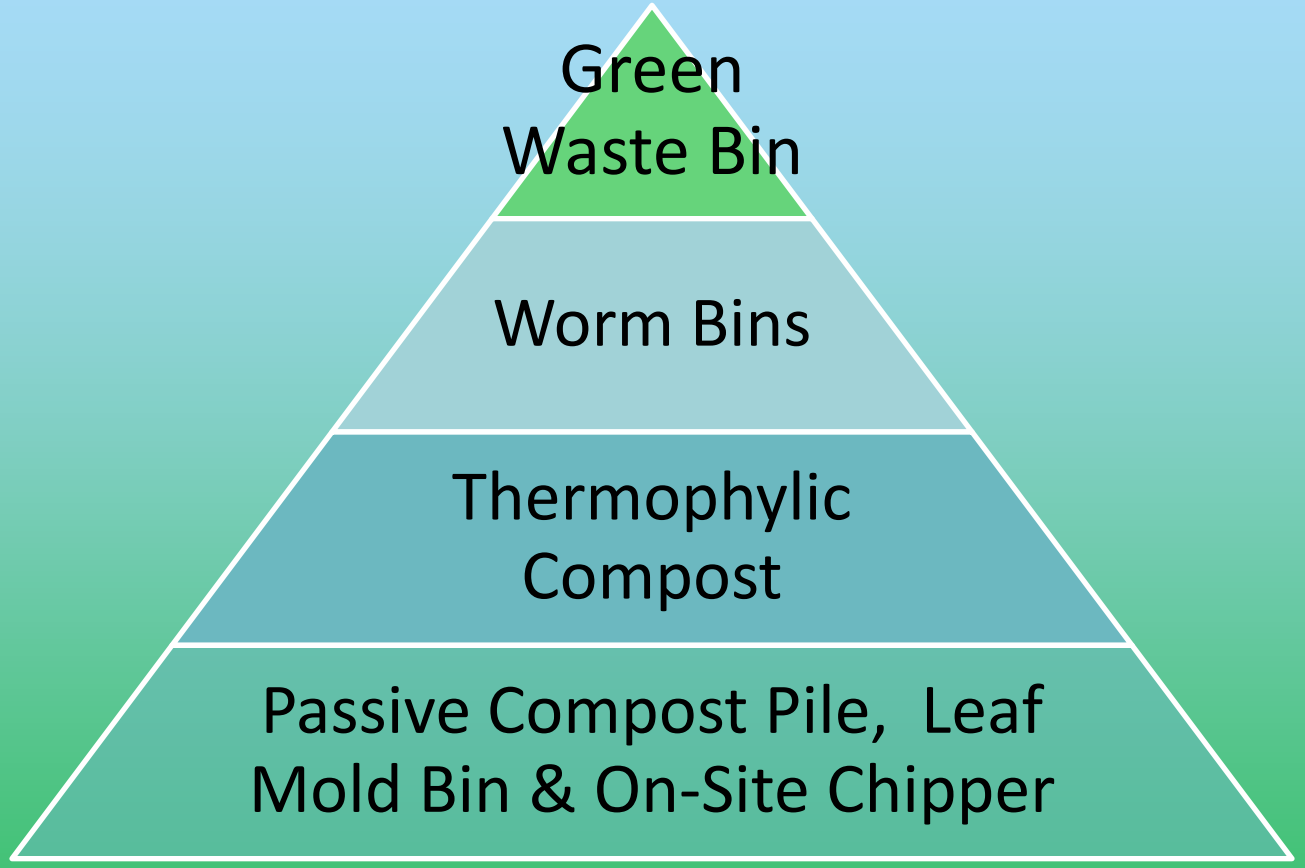
1. Plan

- ✓ Inventory your landscape and refine vision
- ✓ Boost habitat value by planting native plants and other floral resources
- ✓ Draw a simple site plan
- ✓ Perform chemical and biological soil analysis

Key Actions: Fall

2. Start a materials cycling system versus removing organic materials from the site

Organic Matter Cycling



Key Actions: Fall

3. Plant Health Care and IPM

- ✓ Final pruning: Fireblight
- ✓ Deep watering: non-irrigated pines, birches, oaks, redwoods, plants w/compromised roots
- ✓ Clear root collars
- ✓ Apply compost/mulch
- ✓ Remove leaf litter: roses, fruit trees

Key Actions: Fall

4. With a Certified Arborist, monitor trees and woody shrubs:

- ✓ Symptoms of beetles/borers
- ✓ Oak leaf or oak branch die back
- ✓ Fire blight
- ✓ SOD
- ✓ Note: most insects stop flying in Sept/Oct.- eggs laid, overwintering – (Cal. Oak moth flight in October 2013…!)

Key Actions: Fall

5. Plan for IPM Treatments by a Certified Arborist or licensed Pest Control Professional

- ✓ SOD (Oaks)
- ✓ Dormant Oil, Copper (Fruit trees)
- ✓ Dormant & Horticultural Oils (variety of trees/shrubs)
- ✓ Refer to UC IPM guidelines

"That land is a community is the basic concept of ecology, but that land is to be loved and respected is an extension of ethics.

That land yields a cultural harvest is a fact long known, but latterly often forgotten."

Aldo Leopold. *A Sand County Almanac.* 1948