MASTER GARDENER
COLORADO STATE UNIVERSITY
EXTENSION

CMG GardenNotes #101

IPM and Plant Health Care

Gardening and the Environment

Gardens and landscapes do not exist in a vacuum, but as part of a larger urban/suburban or rural ecosystem. Landscape maintenance and gardening practices may have positive or negative influences on the health of the neighborhood environment. For example, turf enhances the environment by:

- Converting carbon dioxide to oxygen.
- Increasing water infiltration into the soil.
- Reducing surface runoff and erosion.
- Reducing dust.
- Providing a micro-ecosystem that effectively breaks down pollutants.
- Moderating summer temperatures.
- Creating a pleasant "people" space.

On the other hand, lawn care practices negatively affect the environment when grass clippings are mowed or blown onto the street (water quality problem), when fertilizers are over-spread onto hard surfaces, and when the unwarranted use of pesticides occur. Maintaining turf requires energy for equipment and supplemental water use.

Gardeners and land managers must make decisions that consider as many of the possible effects of management as possible, weighing costs and benefits for both the user and the environment. *Integrated Pest Management* and the concept of *Plant Health Care* provide a user-friendly framework for these choices.

Integrated Pest Management, IPM

Integrated Pest Management, IPM, incorporates a variety of strategies for pest and disease management, including cultural, mechanical, biological, and chemical methods. It is "integrated" because the pest management techniques are compatible with one another and with the environment; having re-enforcing rather than competing effects. IPM objectives include minimizing both pest damage and health/environmental hazards while maintaining plant quality above a predetermined economic or aesthetic threshold.

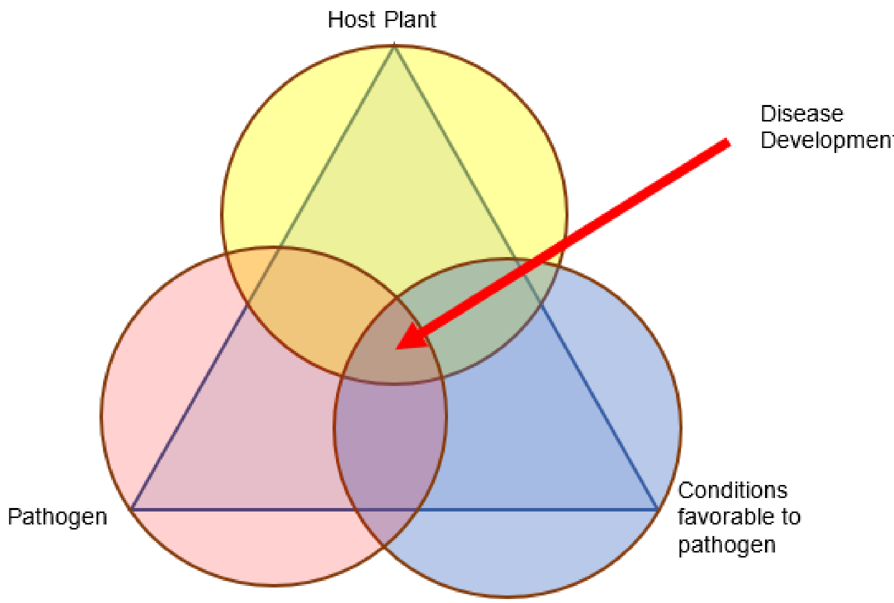
Because insect and disease problems and their consequences vary significantly from crop to crop, application of IPM principles is *situational*. The IPM techniques used in an alfalfa field (perennial crop), a wheat field (annual crop), and an apple orchard (perennial crop with minimal tolerance for pest damage) and the landscape (site with multiple plant species and high tolerance to pests) will be vastly different.

The use of IPM ensures a holistic approach, minimizing (or eliminating) the use of pesticides.

IPM Strategies

IPM requires careful observation of plants and landscapes to correctly diagnose plant pests, diseases, and disorders. In order for a plant problem to develop, three things are required: the pest or pathogen must be present, a suitable host plant must be present, and conditions favorable to pest/disease development must occur. When all three factors are present over a required period of time, a pest or disease problem develops. This concept is illustrated by a "disease triangle" (or "pest triangle," etc.). [**Figure 1**]

Figure 1. Disease Triangle



Successful application of IPM relies on interrupting the cycle of pests or diseases by eliminating one or more of the contributing factors from the disease triangle. For example, not planting (or removing) all susceptible host plants for a pest or disease would prevent that disease from developing (e.g. Mountain Pine Beetle is not a problem in landscapes without pine trees). Depending on the plant problem being managed, different "corners" of the triangle may be simpler or more difficult to eliminate.

A generalized IPM "to-do" list could look like this:

1. Identify the Plant
    - What is normal?
    - What is not?

2. Identify the Problem
    - Was it sudden or progressive?
    - What are the signs and symptoms?

3. Read/Refer
    - What diagnoses are possible?
    - What can be ruled out?
    - What tests or other methods could be used to confirm a diagnosis?

4. Evaluate if Management Is Needed
    - What is the threshold for treatment for this crop/plant?

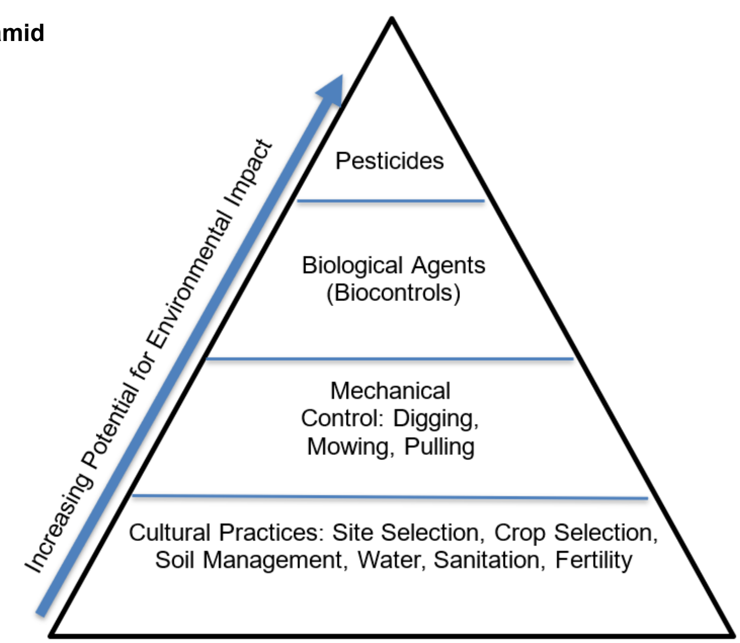
5. Determine the Treatment Options in **This Situation**.
    - On what should management focus (host, pest, conditions?)
    - What treatment options are available?
        - Cultural.
        - Mechanical.
        - Biological.
        - Chemical.

IPM Techniques

Integrated Pest Management control options (cultural, mechanical, biological, and chemical) are often organized on a “pyramid,” [**Figure 2**] showing various techniques from commonly used, “foundational” cultural controls at the bottom to chemical controls (pesticides) at the peak. The further up the pyramid you go, the higher the potential for environmental impact from the chosen method. Each management situation begins at the bottom and works up the pyramid to the level where a pest or disease is suppressed below the desired threshold.

Remember, each method applied will be “integrated” with the preceding control measure. One would not apply insecticides if releasing beneficial insects were part of the management strategy, for example, or use tillage to control weeds where cover-crops were being employed at the same time.

Figure 2. IPM Pyramid



Cultural Methods

Plant Selection: Right Plant, Right Place – Select plants that are adapted to the site conditions.

Soils Management – Many landscape plant problems relate to soil conditions.

- Manage soil compaction (low soil oxygen and poor drainage).
- Manage soil drainage.
- Improve soil tilth with applications of organic matter.
- Nutrient (fertilizer) management.

Water and Irrigation Management

- Water plants appropriately. The water requirement for plants to survive compared to the water needed for plant growth may be vastly different.
- Use plant tolerance to wet or dry conditions in water management.

Pest Exclusion

- Covers and barriers.
- Traps.

Physical Removal

- Hand picking insects.
- Pulling weeds.

Biological Methods

Biocontrols – use of predators, parasitoids, and disease organisms (usually invertebrate) of the pests of plants.

- **Preservation or Conservation Biocontrols** is taking steps to encourage naturally occurring predators and parasitoids through habitat improvement (often considered a cultural control).
- **Augmentation Biocontrol** is the purchase and release of predators and parasitoids, also known as “bugs for hire.”
- **Pesticides** are the use of organic or synthetic chemical products that are designed to kill pests. Pesticides have the greatest potential for environmental harm if misused. All pesticides must be applied in strict accordance with the product label.

Plant Health Care, PHC

The term ***Plant Health Care***, ***PHC***, was coined by the *International Society of Arboriculture* to provide a framework for IPM techniques as they apply to tree care and landscape maintenance.

Concepts of PHC include:

Healthy plants have fewer pests. Many insects and diseases only affect stressed plants. Minimizing stress can therefor prevent many common pests. For example, *Cytospora* canker fungus and many borers only attack trees stressed by factors such as soil compaction, drought, or root damage.

Healthy plants are more tolerant of pests. For example, aphids on shade trees generally do not warrant management efforts. Only those trees that are stressed by drought, non-established root systems, limited root spread, etc. are intolerant of aphid feeding.

Life cycle: Plant needs change with stages in their life cycle. A plant's needs for irrigation, fertilizer, pruning, etc., and its tolerance to pests change through the year and through the life of the plant.

PIC cycle: Plant problems are not created equal. Plant disorders can be "predisposing," "inciting," or "contributing" factors of decline.

The PIC Cycle

Plant pests and diseases vary in their impact on plant health. Some cause chronic or acute stress, weakening a plant's defenses. Others attack healthy plants; still more only develop on plants that are already in decline for other reasons. Understanding the biology of plant pests and diseases can help one to make good decisions about management.

Predisposing factors reduce a plant's tolerance to other stressors. These factors should be considered in plant selection – putting a plant in a stressful location will challenge the plant's survival from the very beginning. Examples of predisposing factors include:

- Planting trees in a site where root spread will be restricted due to soil compaction or hardscape features.
- Chronic drought stress.
- Planting trees susceptible to iron chlorosis in soils with high pH or heavily irrigated soils.
- Failure to structurally train young trees (predisposing trees to storm damage).
- Most leaf-chewing insects, such as caterpillars and sawfly larva.
- Most sap-sucking insects, such as aphids and leafhoppers.

Inciting factors include primary insect, disease, and abiotic disorders that attack healthy plants or cause acute stress. Examples include:

- A soil compaction "event," the most common stress factor leading to many insect and disease problems.
- Planting trees too deep (leads to trunk girdling roots).
- Acute drought.
- "Outbreak" populations of certain insects (e.g., Mountain Pine Beetle or Ips Beetles).
- Many invasive insects, like Emerald Ash Borer, Asian Longhorn Beetle, or Spongy Moth.
- Bark damage from lawn mowers.
- Bark cankers and frost cracks from rapid winter temperature changes coupled with winter drought.
- Phytophthora, Verticillium, Fusarium, and other fungi.

Contributing factors include secondary insects, diseases, and disorders that affect plants that are already stressed. They often are noticeable, lead to the plant's death, and frequently the target of management efforts that would be better directed toward predisposing or inciting factors. Examples include:

- Most bark beetles and borers (secondary to soil compaction, drought, and wind damage).
- Cytospora fungus (secondary to soil compaction, drought, and restricted rooting system).

- Trunk girdling roots caused by planting too deep.
- Iron Chlorosis resulting from chronic springtime overwatering.

Management of contributing factors typically ultimately fails unless the predisposing and inciting factors that stress the plant are addressed.

Life Cycle of a Plant

A key concept in PHC includes recognizing that plant care changes with various stages of growth. Failure to relate cultural practices to the life cycle often leads to reduced growth and confusion about appropriate cultural practices. **Tables 1** and **2** give an overview of the life cycle of trees.

Life Cycle of a Tree

1. Nursery production.
2. Establishment phase.
3. Growth phase.
4. Maturity.
5. Decline phase.

Life Cycle of a Vegetable (annuals)

1. Seed germination and emergence.
2. Seedling growth.
3. Growth phase.
4. Flowering and fruiting phase.

Table 1. Generalized Life Cycle of a Nursery-Grown Tree

Growth Phase	Growth Objectives	Change to Next Growth Phase
Nursery production	Top growth = selling price.	Planting.
Establishment phase	Root establishment.	When roots become established, length of annual twig growth significantly increases.
Growth phase	Period of canopy growth. Balance canopy growth with root growth limitations.	Growth slows as tree approaches mature size (for site).
Maturity	Canopy growth slows as tree matures. Balance canopy growth with root growth limitations.	Accumulation of stress and age. Minimizing stress on aging trees prolongs tree life.
Decline phase	Minimize stress levels.	Death.

Table 2 – next page.

Table 2. Influence of Life Cycle on Cultural Practices for Trees				
Growth Phase	**Irrigation Water Need**	**Fertilization**	**Pruning**	**Pest Tolerance**
Nursery production	Water = Growth.	Fertilizer pushes desirable top growth.	Structural training desirable.	LOW, could influence sales.
Establishment	CRITICAL. Trees are under water stress due to the reduced rooting system.	None to very little as high nitrogen forces canopy growth at the expense of root growth.	Heavy pruning slows root establishment.	LOW due to drought imposed by reduced root system.
Growth	Water = Growth. Good tolerance to short-term drought. However, short-term drought will slow growth.	If other growth factors are not limiting, fertilization supports growth.	Structural training sets the tree's structural integrity for life.	HIGH except in stress situations.
Maturity	Good tolerance to short-term drought. Severe drought leads to decline.	Need for fertilizer reduces. Over fertilization could force canopy growth that the roots cannot support in summer heat and wind.	Maturing trees that were structurally trained while young have minimal needs for pruning.	HIGH except in stress situations.
Decline	Intolerant of drought.	Evaluate stress factors as fertilization can accelerate stress in some situations.	Pruning limited to cleaning (removal of dead wood). Do not remove healthy wood on stressed trees.	LOW, pests could accelerate decline.

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Reviewed March 2023