

Principles of Integrated Pest Management for Home Gardens and Landscapes

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Introduction

Integrated pest management (IPM) is an approach used in commercial agricultural production to conserve resources, save money, and act in an environmentally friendly manner.

The principles of IPM are appropriate for the home gardener and landscaper as well.

The goals of IPM for the homeowner include:

- Minimizing the use of pesticides, or using lower risk pesticides
- Improving the resiliency of gardens and landscapes to insect pests and diseases
- Improving the understanding and awareness of the ecology of gardens and landscapes, including the ecology of pests
- Saving money

Principles of Integrated Pest Management

The basic key to an IPM approach is to

- Identify pests
- Determine if those pests are causing a problem
- Use non-chemical methods to address the problem
- Use pesticides if necessary



The two-spotted lady beetle is a welcome visitor to every home garden since they have a voracious appetite for aphids. Images: Adalia bipunctata, by Gilles San Martin. Creative Commons license. Via Wikimedia Commons.

- Use cultural practices to improve the resiliency of the garden or landscape
- Often, keep records of problems, actions, and results

Monitor and identify pests

Most avid home gardeners are likely to be able to identify common pests and weeds. It's not always so easy, however. How many times do you find plant leaves chewed with no culprit in sight? Some invertebrate pests may come out at night, like slugs, or may hide under leaves, like some aphids, spider mites, and whiteflies.

Identification of pests and weeds is critical for an IPM approach.

One reason is that different pests require different cultural or chemical controls.

Another reason is to determine if the identified pest is likely to cause sufficient damage to be a concern.

Finally, certain pests may be an indicator of abiotic conditions affecting plants. *Abiotic stresses* are stresses caused not by other organisms, but by environmental factors. These include temperatures outside the plant's preferred range, too much or too little water, or too much or too little sunlight. For example, some weeds can be considered indicator weeds. Red sorrel may outcompete lawn grass when soil pH is low. And white clover may indicate low fertility soil. Be cautious, though, with these interpretations because it's not the case that indicator weeds grow **only** in these conditions. It's just that they may be an indicator which merits further investigation.

Recognize Abiotic Stress

It's also helpful to know if plants are showing signs of abiotic stress, like too little water, too much water, soil fertility, or low sunlight. On the one hand, pest or disease damage may be made more severe by these abiotic stressors. It's also important to recognize abiotic stress symptoms rather than attributing them to pest damage. In general, understanding plant requirements for good growth or production is a good place to start.



Monitoring for pests and weeds and correctly identifying them is a key for integrated pest management. Image: Girls Examining a Flower, by ShenandoahNPS. Public domain. Via Wikimedia Commons.

Action threshold

An important principle in IPM is to identify the threshold for action. That is, what amount of damage to plants, or population of a pest, is to be observed before it's necessary to take action.

This threshold may be based on individual preference. For example, one person may find some damage to roses by Japanese beetles to be acceptable, but another person may find even a blemish to their prize roses to be unacceptable.

Home lawns are a good example of the wide range of tolerance different people may have for weeds and plant health. Some people may insist on a dark green, uniform, weed-free lawn, while others may be content with a yard composed of a variety of turfgrass and weed species as long as the lawn stays reasonably green and serves to keep soil stable.

Likewise, a small amount of damage to fruits and vegetables may be acceptable. Or may not be, depending on the individual preference, or the type of damage involved. For instance, blemishes on apples may be acceptable, but larvae infesting apples may not be tolerable.

In some cases, there may be established threshold for a given pest species. For example, on turf lawns, a threshold of 10 grubs per square foot is a common threshold (Richmond, 2023). This often comes as a surprise to homeowners, who may be likely to blame turf problems on a far lower density of grubs. Below this threshold, healthy lawns will outgrow the feeding losses to grubs. It should be noted, though, that June beetle grubs have a lower threshold, as they will grow larger than other common white grubs. It's a fun exercise to identify the species of white grubs, which can often be distinguished by the pattern of hairs on their rear ends.



The striped cucumber beetle is a common pest of cucumbers, squash, and melons. Image: Striped Cucumber Beetle, by Katja Schulz. Creative Commons license. Via Wikimedia Commons.



A white grub showing the pattern of hairs on its rear end, which can be used to identify the grub species. Image: White Grub Family, by Gaile P. Buenavides. Creative Commons license. Via Wikimedia Commons.

Determining if pest populations have reached an actionable threshold often requires careful investigation of the causes of problems and careful assessment of the numbers of the pests present.

Good information sources for control methods

Once a pest, weed, or other problem has been correctly identified, and it's determined that the situation requires action, information on the best control methods should be sought. It's often possible to find Cooperative Extension publications that address a specific pest or disease. These publications will often cover chemical and non-chemical control methods.

It's important to give consideration for the geographic source of the information. For example, insect, weed, and plant disease life cycles may be quite different in different climates. And, of course, different regions of the U.S. have different insect and weed species.

In general, .edu or .gov websites can be relied upon for good information. There are also .org sites that can be trusted. While sites and apps can be incredibly useful for identifying pests and weeds, results should also be double-checked with reliable information or with someone with expertise.

Pest management actions

The appropriate actions to take to control insect pests, weeds, or plant diseases is, of course, very dependent on the correct identification of the pest being controlled.

General IPM principles for pest management actions are:

- Use preventative and cultural practices to improve the resiliency of your garden and landscape
- Use physical removal methods
- Use lower risk, narrow spectrum, or biological pesticides
- Use conventional and broad-spectrum pesticides when necessary



The wheel bug is a relatively common assassin bug. They are sometimes rather large and creepy with their slow movements but are considered beneficial insects. They are not usually aggressive but should be approached cautiously as they can administer painful bites to people. Image: Arilus cristatus, by Andy Reago and Chrissy McClarren. Creative Commons license. Via Wikimedia Commons.

For some control approaches, it is important to understand and work with the life cycle of the target organism. For example, weeds are often easier to remove or treat when small. Larvae of some insects may be more susceptible to chemical control than adult insects.

Preventative and cultural practices

The first principle here is “right plant, right place”... with the caveat that if the place isn’t quite right, try to make it better. Soil pH correction, proper irrigation, managing sunlight and air flow, and using raised bed gardens are all possible methods to help plants thrive.

One preventative method is using disease resistant varieties. If a plant disease or pest is known to be a common problem for a crop, there may be resistant varieties available. Many varieties of disease resistant vegetables are available. To select the right variety, it’s important to know the specific plant disease you are trying to avoid.

Considering larger and cuter pests, Rutgers Cooperative Extension (no date) provides a comprehensive list of the resistance of different plants to being browsed by deer.

It’s also important to use proper cultural management like thinning, sanitation (such as removing diseased plant debris), appropriate mowing height for turfgrasses, and proper fertilization and amendment.

In some cases, there may be plants that serve as lures, repellents, or barriers to pests. Common flowers and herbs like marigolds, basil, and chives are sometimes cited as being a potential repellent for some insect pests. The reader is encouraged to learn about specific pests and potential repellents before investing in companion plantings.

Crop rotation for vegetables is commonly practiced at commercial farms. Likewise, at home, if possible, rotate the type of vegetable in a given spot, for instance rotating crucifers (like broccoli), solanaceous plants (like tomatoes), and cucurbits (like squash). (RCE, 2019).

Physical removal methods

Physical removal methods include approaches like pulling weeds, physically removing and dispatching insect pests, and trapping vertebrate pests. Any removal method you choose should be tailored to the specific pest you are eliminating.

Perhaps in this category we could also include physically excluding pests, such as fencing to keep out deer, netting to keep out birds, or screening to keep out insect pests.

Chemical control methods

From an IPM perspective, chemical control may be a method of last resort, used when other tactics fail. But it should be noted that an IPM approach does not necessarily avoid the use of pesticides or dictate which pesticides are allowable. The idea is to use an informed and considered approach to pesticide use.

Lower risk and target-specific pesticides

Lower risk pesticides may include organic pesticides, biological pesticides, or synthetic pesticides that affect a narrow range of organisms or are less harmful to non-target organisms.

Some organic pesticides include neem oil, insecticidal soap, horticultural oil, spinosad, and others. Note that these are still considered to be pesticides since they are used to kill pests.

Some of these products work only for a specific set of insects or for a limited set of life stages of a given insect. Nitzsche and Ghidui (2024) list conventional pesticide, organic pesticide, and cultural control options for specific pests common to home vegetable gardens.

One shouldn't assume that organic products are necessarily less harmful than conventional pesticides. As an example, neem oil both repels and kills a broad spectrum of insects. It can cause skin and eye irritation, and there have been reports of more severe harm to cats. It also may not be effective against all insect pests. As always, with an IPM approach, understanding the target pests and appropriate treatments is key.

Also, if you're interested in using an organic approach, be sure to look at the label information on the specific product. Sometimes conventional pesticides are used in these products. For example, insecticidal soaps sometimes include pyrethroid insecticides. For organic land care information, see the *Rutgers Organic Land Care Manual* (Rowe and Bakacs, 2017).

Acetic acid, or *horticultural vinegar*, is a common broad-spectrum herbicide used as an alternative to other broad-spectrum herbicides like glyphosate. The acetic acid products sold for horticultural use are usually 10–20% acetic acid and is usually not derived from vinegar. It's effective for quick burn-down of weeds and potentially to kill weed plants. It's not free from potential negative effects, though. It has the potential to cause burn skin and severe eye injury. Skin irritation and allergic reactions are also possible. (See, Smith-Fiolan and Gill, 2024).

In all cases, follow the label instructions on all pesticide products, including organic pesticide products. Product labels often give information on handling and using the product safely, as well as considerations for its environmentally responsible use. Remember that the label is the law.

Biological pesticides

Biological pesticides are also called *biopesticides*. Perhaps the most popular biological pesticide is Bt (*Bacillus thuringiensis*), a bacterium that attacks certain flies, such as mosquito larvae, beetles, such as beetle grubs, moths, or nematodes. Note that specific strains of Bt are used for specific target organisms.

Biological control

It's helpful to promote conditions for beneficial insects like ladybird beetles (ladybugs), praying mantids, pirate bugs, lacewings, parasitic wasps, predacious flies, assassin bugs, and spiders

(Ghidiu, 2008). Note that using broad spectrum insecticides, especially over a large area, is likely to kill beneficial insects along with the targeted pests.

Some beneficial insects can be purchased for release in gardens and landscapes.

It's also beneficial to create habitat for other predators, like birds and bats.

Conventional pesticides

It's helpful to understand the potential effects of both conventional and non-conventional pesticides. For example, pyrethroid insecticides are synthetic pesticides that are considered lower risk than some other pesticides because they have low toxicity to mammals. This is why you can spray your clothes with permethrin before you go hiking or apply it in a cream directly to your skin to treat scabies. This is an improvement over organophosphate insecticides that, as acetylcholinesterase inhibitors, unfortunately affect the nervous system of people the same way they affect the nervous system of insects. Pyrethroids are a concern in the environment, however, because they are toxic to insect pollinators, and also to fish and aquatic invertebrates if they make their way to streams and lakes.

Documentation and record keeping

A keystone of commercial IPM programs is good record keeping. This might include pests encountered, dates, density of pests, actions taken, and results.

To the extent possible, it's good to keep these kinds of records at home as well. This information can improve future pest management efforts. It's also valuable for learning about the ecology of pests and weeds in your own garden, and the yearly variations in their occurrence and numbers. Finally, it can better help estimate the costs and benefits of your actions.

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