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Cooperative Extension Service

Integrated Pest Management

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In this chapter:

Pests can be insects, weeds, vertebrates, and diseases. Any organism that causes harm to crops, livestock, or humans can be considered problematic and therefore must be managed. In Extension, we practice and teach that pest management is best accomplished through a holistic approach called integrated pest management, or IPM.

What is IPM?

The history of IPM traces back to research done in the early 1900s that focused on how to best use early insecticides in ways that wouldn't harm beneficial natural enemies such as lady beetles. That way, growers could receive the benefits of both pesticides and biological control. By the 1970s, IPM became more formalized as a philosophy of pest management that focuses on utilizing the best set of tools to suppress a pest population, rather than relying on any one method.

In many ways, IPM as we know it is a response to the heavy use of insecticides such as DDT in the middle part of the twentieth century. Some always define IPM as the avoidance of insecticides and other pesticides. IPM does not necessarily exclude pesticide use or consider pesticides the "weapon of last resort."

Another issue, in modern times, is that IPM is sometimes conflated with organic agriculture. IPM is not inherently organic, as some IPM programs include the use of synthetic pesticides that would not be allowed on an organic site. What is most accurate to say is that integrated pest management is located between the traditional "spray 'em all" approach and the "never use pesticides" perspective; it is a judicious use of all possible tools that will help to suppress a given pest.

Developing an IPM Program

Monitoring

The foundation of success for IPM is a good monitoring program. Monitoring for insects, weeds, and diseases allows populations to be caught when they are easiest to manage, and suppression will be more successful. In a more traditional approach, action might not be taken until a high amount of damage has occurred and pest populations are difficult to manage. Other times, a preventive application of pesticides may be applied without verification that the target pest is even present. By monitoring, those methods can be minimized or avoided.

Monitoring can be achieved in multiple ways:

- Regularly inspect plants, paying close attention to new growth. Check flowers, leaves, fruits, and stems. Not every plant has to be inspected necessarily. Designating certain plants in the garden or field as the check plants for a row or patch can save time while still allowing for monitoring.
- Plants should be checked for signs (the actual pest organism) and symptoms (the evidence a pest leaves behind). A hand lens or magnifying glass can help to magnify signs and symptoms for easier identification. Depending on the pest, it may be prudent to check at night rather than during the day to confirm the problem.
- Insect pest populations can sometimes be monitored with traps. Yellow sticky cards, yellow bowl traps, pheromones traps, and bait traps can be deployed and checked regularly for the presence of pests. Once a certain number are trapped, a treatment regime might be recommended.
- Diseases and weeds can often be tracked via weather and climate models. For example, fire blight has parameters for its emergence that can be tracked and predicted. The University of Kentucky provides prediction model tools, such as those available online at http://weather.uky.edu/plant_disease.html, to help growers monitor for conditions that lead to disease.

Monitoring also includes creating records and maps of pest problems. By keeping track of pests on an annual basis, this allows for more predictability in the garden, and maps can help focus management efforts on hot spots.

Despite the power monitoring gives growers, it is often the most neglected aspect of pest control. It takes time and dedication—both of which can be in short supply! It is important when teaching about pest management to emphasize how important monitoring is.

Identifying Pests

Monitoring for pests is only half the battle though. Once a pest has been captured or seen, or its damage has been observed, it is necessary to figure out its identity. Identification tips have been covered in other chapters in this manual for various types of pests. Identification is necessary for IPM, as it allows for more specific approaches to pests and tailoring solutions to the situation at hand. Identification also helps to rule out possible abiotic problems and guarantee a pest problem.

If identification proves a bit difficult, Master Gardeners, Extension assistants and agents, and Extension specialists may be able to help.

Economic and Action Thresholds

Monitoring for pests allows us to act based on established thresholds for specific pests. There are different types of thresholds: economic and action. Economic thresholds are usually established for large-scale agriculture. These thresholds are calculated to determine the population level at which a pest is causing enough damage to make a suppression method economically sensible.

These economic thresholds don't always apply to the lawn and landscape or to the home garden, where aesthetics may be important or there are only a few plants of a given crop. In these situations, it may be prudent to act on action thresholds. These are sometimes known as aesthetic thresholds, and there is a lower tolerance for the pests in these models. Indoor pests, such as bed bugs or rats, may also have action thresholds. In these instances, just seeing one pest may be enough to begin management.

Evaluating Results

The final step in monitoring is evaluation. Continuing to monitor after a management plan can establish efficacy and suggest new possibilities if the original plan didn't work. It can also help to track issues such as pesticide resistance, which is covered later in this chapter.

Methods of Pest Management

When it comes to suppressing pest populations, IPM relies on a variety of strategies. Some of these are preventive in nature, hoping to reduce the conditions most favorable to pests, while others are reactive to monitoring results or damage in the field.

Cultural Methods

Cultural management alters the current cultural practices to reduce pest pressure or damage from pests. This can include changes to irrigation, fertilization, and sanitation in efforts to prevent or stop pests. These are some examples that may help in the future.

Right Plant, Right Place

One mantra that can help to curtail pest problems before they start is this: "Put the right plant in the right place." Site traits can dictate which plants might best survive in that environment. Soil pH, soil type, moisture retention, growing zone, and more can all impact what the best plant to choose might be. Ignoring these conditions can mean a plant is set up to be stressed and fail from the moment it is planted. Stressed plants suffer from more pests and are easier for pests to harm.

Choosing Resistant or Tolerant Varieties

Beyond choosing a plant best suited for the site, some plants have also been bred to be *resistant* or *tolerant* of certain pests. A resistant plant has been bred to support little to no pests on it. A tolerant plant cultivar has been bred to be able to host pests, sometimes for extended periods of time, without exhibiting symptoms. Plants can be resistant or tolerant to insects and pathogens.

Irrigation and Fertilization

Tending to a plant's water and fertilizer needs can help the plant to stay healthy. A healthy plant can rebuff pests or can sustain more damage without displaying symptoms. This means understanding what the needs of a landscape or garden plant will be and meeting those.

There can also be too much of a good thing. Overfertilization can stress a plant and open it to pest infestation. Fertilization can also sometimes attract pests; insects in particular can be attracted to plants overfertilized with nitrogen. Overirrigating can stress a plant but also creates ideal conditions for pathogens to thrive.

Sanitation

Sanitation is most frequently a preventive pest suppression strategy. Sanitation can be going through a garden in the fall and removing all debris from the growing season. Doing so removes overwintering habitat for multiple pests and may even remove eggs and pupae that were there for the winter. Sanitizing pruners and other gardening tools in between uses can cut down on the spread of pathogens. Use rubbing alcohol, a disinfectant such as Lysol, or a solution of one part bleach to nine parts water. If you are pruning diseased plants, make sure to disinfect tools between each plant. Weed control during the growing season cuts down on alternative hosts and harborage for pests. Finally, the pruning or removal of infested plants can sanitize the garden of pests.

Table 10.1. Plant families for rotations.

Plant Family*	Representative Members
Apiaceae	Carrot, celery, fennel, parsley, parsnip
Asteraceae	Chicory, endive, globe artichoke, lettuce
Brassicaceae	Bok choy, broccoli, Brussels sprout, cabbage, cauliflower, collard, kale, kohlrabi, mustard, radish, rutabaga, turnip
Chenopodiaceae	Beet, spinach, Swiss chard
Cucurbitaceae	Cucumber, melon, pumpkin, squash
Fabaceae	Bean, pea, vetch
Liliaceae (Alliums)	Chive, garlic, leek, onion, shallot
Solanaceae	Eggplant, pepper, potato, tomatillo, tomato

*A more complete list of families and representative genera is in Chapter 5, Plant Diseases.

Crop Rotation

Continuously growing the same plants, or even related plants, in a given area is a recipe for pest problems. Insects will infest the location and disease propagules will be able to persist, as a host is constantly provided. Taking at least a growing season to switch between, for example, potatoes and leafy greens, could break the reproductive success of the potato pests and lead to fewer issues in the future. Crop rotation is often seen in Kentucky in large-scale agriculture with the switching between corn and soybeans. This highlights another benefit of rotation; plants need different nutrient levels, or some may even fix nitrogen. Switching between corn and soybeans can replenish soil and reduce stress levels for future plantings. See Table 10.1 for suggested rotations to utilize.

Physical Methods

Physical management of pests focuses on creating conditions that are unsuitable for pest entry, dispersal, survival, or reproduction.

Barriers to Pests

Row covers are among the most common methods of pest exclusion through physical control. Row covers are sheets that cover rows of plants or individual plants. They can ensure that pests such as squash vine borer, cucumber beetles, flea beetles, whiteflies, aphids, leafminers, and cabbage loopers physically can't feed on or lay eggs on plants. It is important to check under covers frequently for intruders. Pests that do get in are protected from their natural enemies and can do a lot of damage. Remove covers if it gets too hot underneath or if plants are in flower and need pollination.

Similar options can include plant collars that protect seedlings from cutworm damage. Use toilet paper tubes or cut the ends out of tin cans or paper cups to form a tube. Place a tube over each seedling. Bury the edge of the tube one inch deep. Sticky barriers can be used to catch climbing insects as they make their way up a plant's stem. This technique is effective against adult root weevils on ornamentals, ants on fruit trees, and climbing caterpillars and beetles. Rather than applying the sticky adhesive directly to the plant, first wrap the stem or trunk with a three- to four-inch-wide band of paper, plastic, or cotton. Then apply the adhesive to the wrap. Add more adhesive as soon as the trap is covered with insects, dust, or debris.

Physical Removal

If pests penetrate a barrier to entry, it is still possible to create conditions unsuitable for their survival or dispersal. One option is simple handpicking. Plucking pests, weeds, or diseased plant material and removing them from the growing setting can make it more difficult for the pest to proliferate and stop further damage from occurring. Some pests can be dislodged from a plant with a forceful stream of water. Small insects in particular can be susceptible to physical removal with water. Both of these methods will take time and effort to keep up with pests but should eventually lead to lower populations.

Finally, some growers may be able to vacuum pests off plants for physical control. It works best with insects such as whiteflies and spider mites that congregate in groups and do not scatter when disturbed. Use a handheld, wet-dry vacuum to suck these pests from infested plants. For best results, vacuum early in the morning, when pests are lethargic. Seal the vacuum contents in a bag, freeze overnight if possible, and discard.

Mechanical Methods

Mechanical and physical controls are often lumped together, but there is a distinction. Whereas physical control tries to exclude pests, mechanical control involves destroying a pest or its ability to procreate.

Pest Destruction

One of the most common methods of mechanical control is mowing. Mowing removes large parts of weeds and may kill them outright or reduce their ability to procreate. Rototilling is another mechanical method. Tilling will destroy some pests in the soil, such as tomato hornworms. It can also bury and kill others, or it can destroy overwintering shelters, exposing pests to the elements. One of the more extravagant methods of pest destruction is flaming. Both weeds and insects have been managed using fuel-powered jets of flame.

Trapping

Pest traps come in lots of shapes, sizes, and even smells. Traps are often promoted for use in monitoring for pests, but they can in some instances mechanically destroy certain pests. In other cases, traps are less mechanical management and are more of an opportunity for physical removal from the garden or field. Traps can include the following:

- Pheromone traps—Insect pheromones can be used against them by designing a lure and then a trap to hold pests. Again, these are most often deployed as a monitoring tool, although there is an amount of mechanical control that also occurs as insects get stuck in the trap.

Ground beetle larva (left) and adult

Green lacewing larva (left) and adult

Big-eyed bug

Lady beetle larva (left) and adult

Syrphid fly larva (top) and adult

Tachinid fly

Assassin bug

Damsel bug

Spined soldier bug

Minute pirate bug

Robber fly

Figure 10.1. Some beneficial predatory insects common to Kentucky.

- Snap traps and glue traps—These options are used for mechanical destruction of rodent and insect pests. They snare the pest, either with a snapping arm that is triggered by the pest or with glue from which the pest can't escape. Insect-specific traps can include blue or yellow sticky cards that are frequently used in greenhouses or high tunnels.
- Bait or habitat traps—Some traps may contain food or are themselves shelter for pests. These can concentrate pests in one spot, allowing for mechanical destruction or physical removal from the area. One example is an apple-cider vinegar trap to capture vinegar flies; the odor lures them into the container, and they fly into the trap, never to leave. Newspapers and boards can also be set out as shelter for pests like squash bugs. They will hide inside of piles of papers or cardboard or under the boards, allowing a gardener to come out in the morning and dispatch them all in one place.

Biological Methods

Biological methods, or biological controls, are foundational to integrated pest management. At the outset of IPM development, the focus was on maintaining populations of beneficial organisms and avoiding negative impacts from insecticides. To define biological control, it is the use of an activity by one species that reduces the negative impacts of another.

Predators, Parasitoids, and Parasites

The common image of biological control is to use a beneficial predator against a pest. This is a robust and well-researched area, but these are not the only "natural enemies" that can be deployed against pests. There are other categories into which these can be separated.

- Predators: These are animals that attack, kill, and consume multiple prey items throughout their lifetimes. Some predators may specialize more than others, only feeding on specific groups of prey (such as the mealybug destroyer, which specializes on mealybugs). See Figure 10.1 for some Kentucky examples of predaceous insects used in biocontrol.

Table 10.2. Garden flowers that attract beneficial insects.

Common Name (Botanical Name)*	Predators Attracted	Parasitoids Attracted
***Apiaceae* (carrot family)**		
Angelica *(Angelica archangelica)*	Lacewings, lady beetles	—
Anise *(Pimpinella anisum)*	—	Wasps
Blue lace *(Trachymene coerulea)*	—	Wasps
Caraway *(Carum carvi)*	Bugs, hover flies (syrphid flies), lacewings	Wasps
Coriander *(Coriandrum sativum)*	Hover flies	Tachinids, wasps
Dill *(Anethum graveolens)*	Hover flies, lady beetles	Wasps
Lovage *(Levisticum officinale)*	—	Wasps
White lace flower, bishop's weed *(Ammi majus)*	Bugs, hover flies, lady beetles	Tachinids, wasps
Yarrow (*Achillea* spp.)	Bugs, lady beetles	Wasps
***Asteraceae* (daisy family)**		
Blazing star, gayfeather (*Liatris* spp.)	Bugs	Wasps
Chamomile *(Anthemis nobilis)*	Lady beetles	—
Coreopsis (*Coreopsis* spp.)	Lacewings, lady beetles	Wasps
Cosmos *(Cosmos bipinnatus)*	Hover flies, lacewings, minute pirate bugs	—
Golden marguerite *(Anthemis tinctoria)*	Lady beetles	Tachinids, wasps
Goldenrod *(Solidago altissima)*	Bugs, lady beetles, soldier beetles	Wasps
Marigold, signet *(Tagetes tenuifolia)*	Minute pirate bugs	Wasps
Mexican sunflower *(Tithonia rotundifolia)*	Hover flies, minute pirate bugs	—
Sunflower (*Helianthus annuus* and *H. debilis*)	Hover flies, lady beetles	Wasps
Tansy *(Tanacetum vulgare)*	Hover flies, lady beetle larvae	Wasps
***Brassicaceae* (cabbage family)**		
Broccoli *(Brassica oleracea)*	Hover flies	Wasps
Candytuft *(Iberis umbellata)*	Hover flies	—
Mustards (*Brassica hirta* and *B. juncea*)	Big-eyed bugs, hover flies, minute pirate bugs	—
Sweet alyssum *(Lobularia maritima)*	Hover flies	Tachinids, wasps
***Dipsaceae* (scabiosa family)**		
Cephalaria *(Cephalaria gigantea)*	Hover flies	Wasps
Pincushion flower *(Scabiosa caucasica)*	Hover flies	Wasps
Scabiosa *(Scabiosa atropurpurea)*	Hover flies	—

Table 10.2. Garden flowers that attract beneficial insects.

Common Name (Botanical Name)*	Predators Attracted	Parasitoids Attracted
***Fabaceae* (legume family)**		
Alfalfa *(Medicago sativa)*	Bees, bugs, lacewings, lady beetles	—
Clover (*Trifolium* spp.)	Bees, bugs, lacewings, lady beetles	—
***Hydrophyllaceae* (waterleaf family)**		
Fiddleneck *(Phacelia tanacetifolia)*	Bees, bugs, hover flies	—
***Polygonaceae* (buckwheat family)**		
Buckwheat (*Eriogonum* spp. and *Fagopyrum* spp.)	Hover flies	—

*This list includes only some of the many plants whose pollen and nectar attract beneficial insects.

- Parasitoids: These are animals that attach to or live inside one host, which they will eventually kill. Parasitoid insects often inject their eggs into a host, which then usually ceases to be a functional pest. One example is the aphid wasp; it injects an egg into an individual aphid, which serves as a nursery and food for the growing baby wasp. As a result, the aphid feeds less and doesn't reproduce.
- Parasites: Often confused with parasitoids, parasites are animals that infest a host that they typically won't kill, though they may make it sick enough that it causes less of an issue as a pest.

When using these biological control agents, there are different ways to deploy them or utilize them.

- Classical biological control: This is usually done when dealing with an invasive species. The government will dispatch personnel to the invasive species' native range to find predators and parasitoids that coexist with the pest and bring them back to study. They will be checked to make sure they won't also become invasive before possibly being released to manage the invasive pest. One famous example is the use of vedalia beetle to control cottony cushion scale.
- Augmentation biological control: This is the purchase and release of things like predators and parasitoids. For example, one could go to an online retailer and purchase 1,000 lady beetles to release in the garden in the hopes of having them help manage aphids. The most successful stories of augmentation biological control have come from greenhouses or using small or immature biological control agents rather than adults in the field. For example, predatory mites can be released to manage spider mites in a garden.
- Conservation biological control: Agricultural areas or cultural practices can be modified to do less harm to native populations of beneficial organisms. Such conservation biological control could include the creation of naturalized areas, where flowers and insects could live near a field or garden. Any beneficials in these areas may spill over into ag production and

provide benefits. Also, there could be alterations to pesticide use to reduce non-target impacts that harm beneficials. For example, using a granular insecticide rather than a liquid one can keep residues away from non-targets. Table 10.3 highlights some plants that may entice beneficials to dwell near your garden.

Microorganisms

Viruses, bacteria, nematodes, and protozoans are also natural enemies that may help to manage some pest populations. While they aren't as visible as predators and parasitoids, they do persist in nature and provide suppression, even without our input. There are some microorganisms that have been "weaponized" and may be applied to a growing area to provide further pest management. Microorganisms can be used against insects, weeds, and pathogens, though some of the most commonly used ones help with insect pests.

- Bacillus thuringiensis (B.t.) is a bacterium containing a toxin that poisons some insects. When ingested by a susceptible insect, it paralyzes the insect's gut, causing the insect to stop feeding and die within a few days. It is most effective on the youngest life stages. B.t. can be applied but is also deployed through GMO crops, to manage insects feeding on crops like field corn. There are multiple strains of B.t. that can be purchased. Here are a few examples:
  - B.t. *kurstaki* works on caterpillars, the immature forms of moths and butterflies.
  - B.t. *israelensis* is active against mosquito and fungus gnat larvae.
  - B.t. *san diego* is active against Colorado potato beetles and elm leaf beetles.
- Parasitic nematodes, also known as entomopathogenic nematodes, are microscopic roundworms that can infest and kill larval and pupal stages of certain soil-dwelling insects. Once a host has been destroyed, nematodes may burst forth from its body and then infest other nearby hosts.
- Fungi, such as *Beauveria bassiana*, can be applied to infest aphids, thrips, and other soft-bodied insects.

Biological control happens naturally without human intervention, but as shown, there is also opportunity to enhance what goes on naturally. There are some considerations to be kept in mind if biological control is to be a featured part of an integrated pest management plan:

- Biocontrol can have a high upfront cost when first purchasing biological control agents, especially when compared with traditional pesticides.
- Biological control relies upon monitoring and proper pest identification in order to release or apply the biocontrol agent when populations are most susceptible and to ensure the correct natural enemy is purchased.
- Unlike what might be seen after a pesticide application, biological control will never fully eliminate a pest population. There will be background levels of pests present that growers will have to be comfortable with.

But, if properly utilized and supported, biological control methods result in fewer pesticides being applied into the environment, can provide season-long suppression of pests, and may be more cost-effective in the long run.

Chemical Methods

One question that some people ask about IPM is how pesticides can fit into an integrated program. Pesticides, such as fungicides, herbicides, and insecticides, can be an important part of an integrated pest management plan. While reliance on pesticides may hinder IPM, it is also a mistake to discount the effectiveness of these chemicals. Why are pesticides a popular first choice for pest control?

1. Pesticides are readily available and tend to be easy to use.
2. Pesticides tend to be effective at controlling pests.
3. Pesticides usually work relatively quickly, with little lag time between application and control.
4. Large areas can be easier to treat with a pesticide than with methods like physical or mechanical control.
5. Pesticides are also relatively cheap when compared to alternative options such as biological control.

It is also fair to point out that, in some cases, a pesticide may be the only viable option for success against a particular pest.

But there are consequences that may arise from the use of pesticides as well. Pesticides can pose a hazard to the applicator, as well as anyone else who may be exposed to residues after the application. Further, pesticides can have impacts on the environment; this can come from misapplication or through circumstances like drift. When this happens, ground and surface water may be contaminated; fish, birds, and other invertebrates may be killed; and non-target insects and plants may be damaged. By carefully considering the situation and needs where a pesticide may be deployed, we can make decisions that help to minimize the chances of these negative outcomes and successfully control pests.

The ultimate goal when using pesticides is to choose the least toxic material that will satisfactorily manage a pest in the most economical way possible. All pesticides have an inherent *hazard*; they pose a potential to harm. However, hazards can be avoided by minimizing *risk*, which is a combination of hazard and exposure. To reduce risk, we must consider things like the following:

- The pesticide's formulation, or the mixture of ingredients, which can dictate the way the product is applied. Common formulations include aerosols, dusts, granules, and wettable powders. A more complete list of formulations can be found here: http://npic.orst.edu/factsheets/formulations.html. Choosing different formulations can reduce the risk of pesticides. For example, choosing an insecticide granule rather than a liquid spray can cut down on exposure to residues for bees in the landscape.

- The pesticide's active ingredient, or the chemical in the product that manages the target pest. Different active ingredients pose different levels of hazard. A pesticide's label should dictate what non-target organisms may be at risk if exposed to the product, allowing for informed choices between different active ingredients.
- The application methods used for pesticides. By changing the time of day that a pesticide is applied, risk can be greatly reduced. For example, treating at dusk avoids non-target pollinators. Other options include spot treatments of small areas rather than treating entire landscapes, reducing dosages, and employing low-volume applications.

Another part of using pesticides as part of IPM is recognizing the potential for pesticide resistance. Resistance occurs due to the pressure being placed on populations of pests by pesticides. A random mutation may occur, or the pest could be naturally predisposed to resistance, but either way, a population will slowly be able to withstand applications of products that had previously been effective at killing them. As part of an IPM program, pesticide rotation must be practiced. Rotation describes using a different ***mode of action*** against pest populations that have already been treated. Modes of action are the ways in which an active ingredient kills the pest. By switching between different modes of action, we are targeting different systems inside of the pest and reducing the chances that resistance may arise. This is part of ***pesticide stewardship***, a way of making sure that pesticidal tools are effective for longer periods of time.

By taking all of these factors into consideration, nuanced decisions about pesticides in an IPM plan can be made. Rather than relying on "one-size-fits-all" pesticide applications, pesticides should be deployed in the least disruptive way possible. They don't have to be consider the final option for an IPM program.

PAMS

There is a somewhat new way of recontextualizing the many methods of pest management that are a part of IPM. It is called PAMS, which stands for prevention, avoidance, monitoring, and suppression. Some growers and educators find PAMS helpful to create a sequential plan of action, as opposed to the list of options that IPM sometimes becomes.

- Prevention: Prevention is the practice of keeping a pest population from infesting a field or site and should be the first line of defense. Prevention typically uses cultural methods, in particular sanitation, alternative host removal, and proper irrigation, to prevent conditions that favor pests.
- Avoidance: Avoidance may be practiced when pest populations exist in a field or site but the impact of the pest on the crop can be avoided through cultural practices. This includes choosing resistant and tolerant cultivars, crop rotation, and altering planting dates.
- Monitoring: Monitoring and proper identification of pests through surveys or scouting programs, including trapping, weather monitoring and soil testing where appropriate, should be performed to see if prevention and avoidance have been successful, or if further action is needed. Monitoring involves the many tools and traps listed earlier in the chapter.
- Suppression: Suppression of pest populations may become necessary to avoid economic loss if prevention and avoidance tactics are not successful. The primary suppressive tactics that growers can employ include cultural, physical, mechanical, biological, and chemical control. This includes the options outlined above.

To learn more about PAMS, see this link: https://www.canr.msu.edu/ipm/uploads/files/NRCS/PAMSapproach2010-9-1new.pdf

PAMS does not replace IPM as much as it offers an alternative perspective on teaching IPM to growers. The more sequential nature utilizes all the same tactics that are usually taught with IPM, but it just puts them in a slightly different order.

For More Information:

https://ipmworld.umn.edu/
https://ipm.ca.uky.edu/
http://npic.orst.edu/

Photos by Ric Bessin and Blake Newton, Entomology, University of Kentucky.

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