

Figure 1, Graphic showing the major steps of a responsible IPM program. By: <https://kogt.com/integrated-pest-management-ipm-defined/>

How can the use of Integrated Pest Management Strategies, be used to educate Landscape Industry Employees and Environmental Policy-Makers on the benefits IPM has on ecological health in urban Cincinnati?

Quinn Leibold

How can the use of Integrated Pest Management Strategies, be used to educate Landscape Industry Employees and Environmental Policy-Makers on the benefits IPM has on ecological health in urban Cincinnati?

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“In the intricate dance of nature, insects are the choreographers of biodiversity” -E. O Wilson

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Previous Experience

2024-2025

- Spring 2025, Horticulture Final Project, Hort 4092
- Professor Stevie Famulari
- Projects; Senior Capstone

- Spring 2025, Horticulture Science II, Hort 1011
- Professor James Hansel
- Projects; Category 6A, IPM Presentation

- Fall 2024, Horticulture Crop Physiology, Hort 4020
- Professor Dan Petersen
- Projects; N/A

- Summer 2024, Edibles for Sustainable Landscapes II, Hort 3031
- Professor Brian Grubb
- Projects; Insect pest reports on Bearcat Garden

2022-2023

- Spring 2023, Landscape Pests and Controls, Hort 205
- Professor Heather Augustine
- Projects; Insect and weed identification presentation

- Fall 2022, Turfgrass Management, Hort 125
- Professor Kyle Williams
- Projects: Weed book, Insect book

Abstract

Integrated Pest Management (IPM) is a sustainable decision-making process that uses information on pest biology, environmental data, and technology to manage pest damage in a way that minimizes both economic costs and risks to people, property, and the environment. IPM uses four major components; cultural control, mechanical control, biological control, and chemical control in order to support prevention of insect pest and pathogen problems in the landscape.

Landscape industry employees (landscapers, contractors, garden centers, horticulturists, arborists, lawn care professionals, landscape architects) and environmental policy-makers need education on the four components of integrated pest management in order to conserve beneficial insects in the landscape, make improvements to the ecological health in urban Cincinnati and to make quick, insightful, and smart decisions when it comes to prevention and control of insect pest and pathogen problems. This project explains the educational strategies that landscape industry employees need in order to fulfill this initiative.

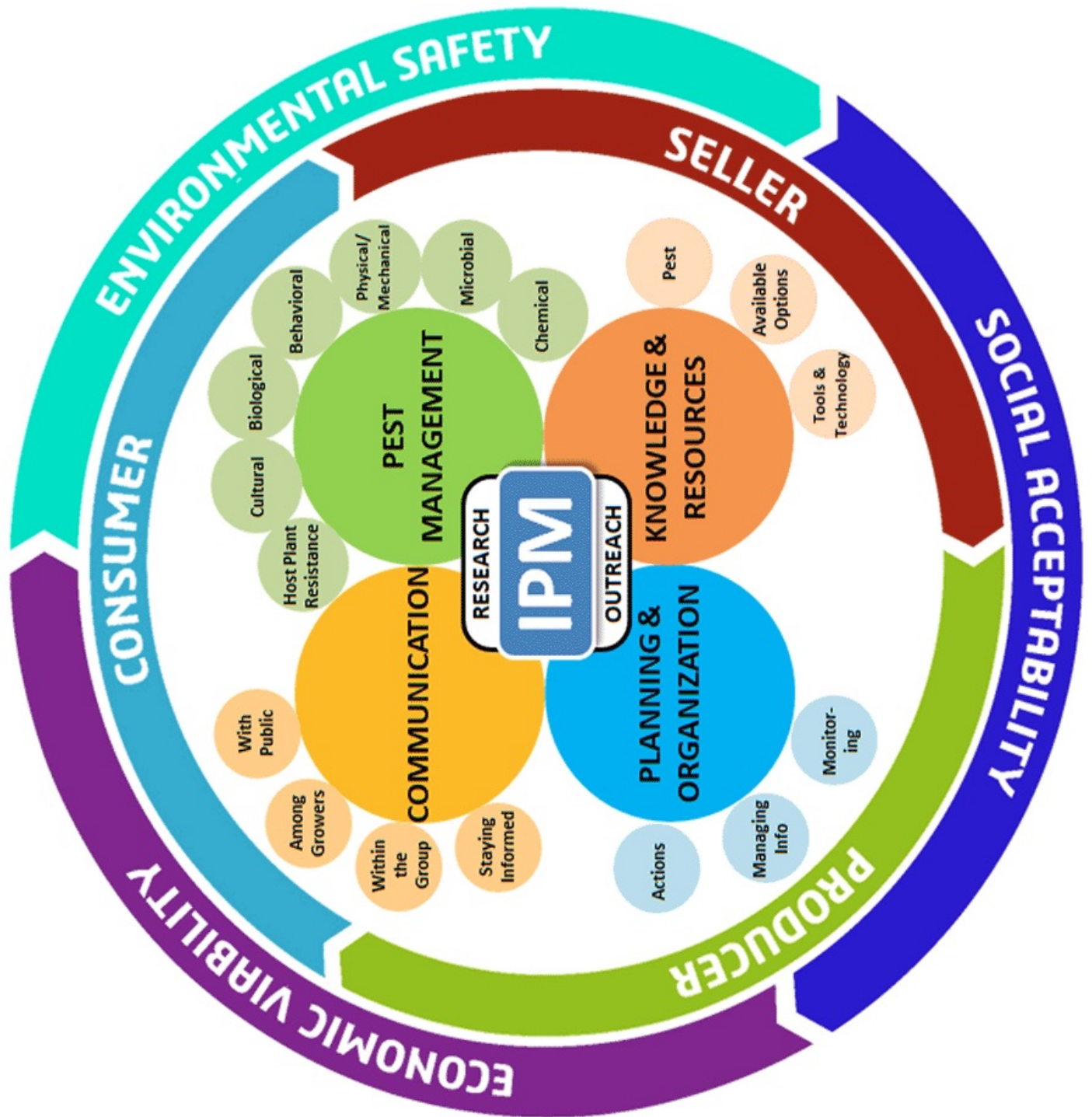


Figure 2, Graphic showing integral parts that make up a successful IPM program in society. By: <https://researchoutreach.org/articles/integrated-pest-management-advances-sustainable-food-production-food-security/>

Key Words

Beneficial Insect: Insects that help the environment by pollinating plants, controlling pests, and recycling nutrients.

Biological control: The use of natural enemies to reduce or eliminate pest populations.

Chemical control: The use of chemical substances, typically pesticides to manage or eliminate pest, weeds, or pathogens in the landscape.

Cultural control: The deliberate alteration of a garden or ornamental plant system to reduce pests.

Ecological health: The relationship between human health and the environment.

Environmental policy-makers: People who are hired or elected to create laws and regulations to protect and manage the environment.

Insect pest: An insect that harms people, animals, plants, or property.

Integrated Pest Management: An environmentally-friendly and economical method of controlling pests that uses a variety of techniques to prevent or reduce damage.

Landscape industry employees: People who work in the maintenance, design, and installation of outdoor spaces.

Mechanical control: The use of physical methods and devices to disrupt or remove pests and weeds.

Project Statement

How can the use of Integrated Pest Management Strategies, be used to educate landscape industry employees and environmental policy-makers on the benefits IPM has on ecological health in urban Cincinnati?

Integrated Pest Management is a continually improving initiative that is beneficial to both conservation of beneficial insects and ecological health in urban Cincinnati. However, landscape industry employees require education on the four main strategies of IPM in order to carry out this initiative.

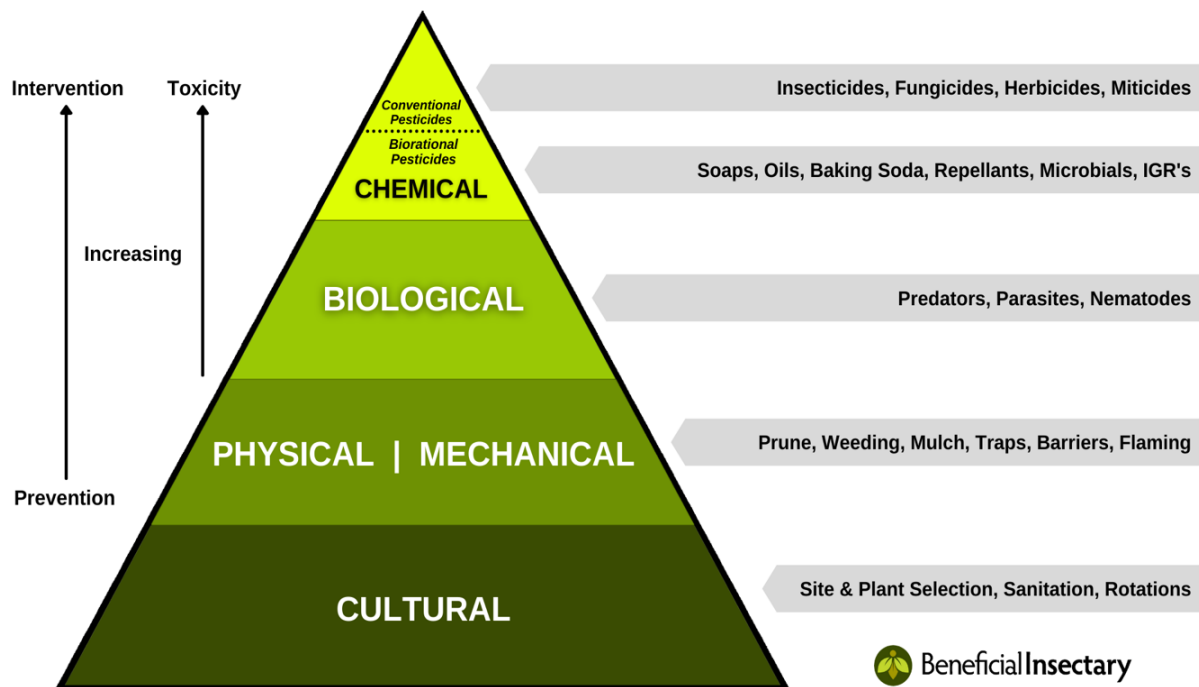


Figure 3, Triangle showing the different control methods of IPM and what each method entails.
By: <https://insectary.com/ipm/>

Project Justification

As someone who has worked in the landscape industry for more than ten years, I can say from experience that education in IPM for the industry is currently lacking. Until I went to college for horticulture, I myself was uneducated and performing incorrect methods. Knowledge in IPM is not something that you are born with. It can be complex and takes a significant amount of strategy and planning in order to be executed ethically and efficiently, as well as to keep up with current options in IPM education.

This is why education for the landscape industry employees is important. As more pests and pathogens are introduced into the landscape, IPM will continue to grow as a critical process in support of ecological health for urban Cincinnati. Landscape industry employees not only need to be educated on the four major strategies of IPM (cultural control, mechanical control, biological control and chemical control) they also need programs and certification (as you would need for a pesticide license) in order to conduct IPM in a safe, ethical and efficient manner.

Integrated Pest Management (IPM)

Physical or Mechanical Strategies

Physical or Mechanical Strategies involve the use of physical barriers, tools, or methods to prevent, monitor, or control pests including:

- Implement monitoring and inspection strategies to identify pest populations.
- Row covers protect crops from insect pests while allowing sunlight, air, and water to reach the plants.
- Traps, such as sticky and pheromone traps, target adult pests and monitor pest populations.
- Handpick or vacuum large pests and remove them from the site.
- Apply mulch around the base of plants and over growing areas using small to medium-sized organic materials.
- Distribute diatomaceous earth (DE) to create unfavorable conditions for pests.
- Weed or cut back overgrown or aged plants to remove pest habitats.
- Prune dense or diseased plant parts to improve air circulation and sunlight penetration.
- Disrupt pest mating and egg-laying patterns by turning over the soil and removing or destroying pests.

Cultural Strategies

Cultural Strategies focus on creating an environment that is favorable for plants and less hospitable to pests.

- Crop rotation maintains healthy, nutrient-rich soil and clean growing areas.
- Familiarize yourself with companion plants, and inter-plant herbs and flowers to promote mutual health. Choose naturally pest-resistant plant varieties and time your planting with periods of lower pest activity.
- Plant a variety of crops close together to mimic natural diversity and resilience.
- Plant "trap crops" to attract pests away from your main crop.
- Thoroughly clean and inspect tools and equipment before, during, and after use.

Biological Control

Biological Strategies involve the use of living organisms to control pests including:

- Integrate beneficial microorganisms, such as mycorrhizal fungi and beneficial bacteria, into the soil to transform organic material, enhance soil health, and improve plant nutrient uptake.
- Introduce beneficial nematodes to target soil pests that cause plant damage.
- Use microbial agents that produce bacteria harmful to specific pest insects.
- Incorporate entomopathogenic fungi like Mycostop, which infect specific insects without harming beneficial ones.
- Introduce red wiggler worms to promote healthy soil that helps plants resist pests.
- Introduce natural predators like ladybugs, parasitoids, predatory mites & more.

Chemical Control

Chemical control uses pesticides only when needed and alongside other methods.

- Read the instructions carefully and apply only the necessary amount, using more won't speed up the process.
 - Choose the most selective pesticide to target specific pests effectively.
 - Naturally derived pesticides, such as insecticidal soaps, effectively target pests and are eco-friendly.
- Use bait stations instead of sprays whenever possible, or spot-spray targeted areas instead of the entire space.

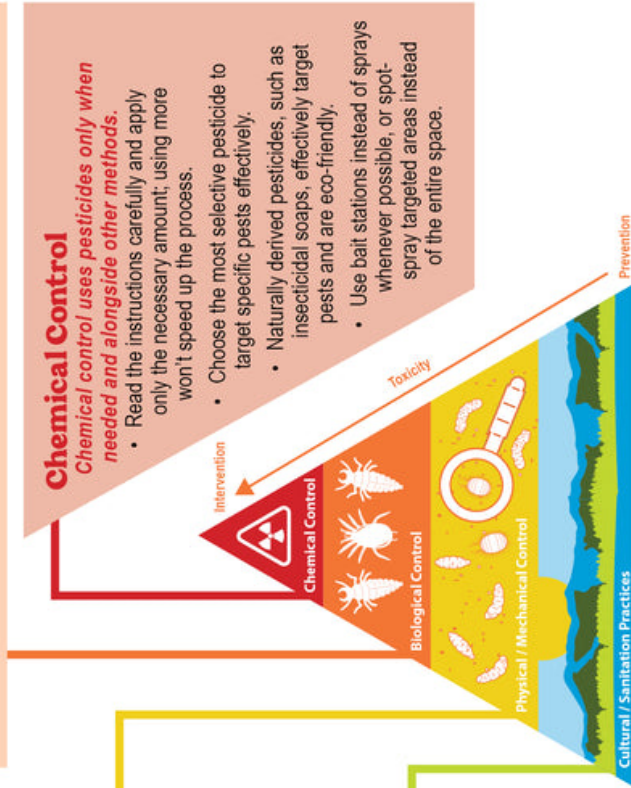


Figure 4, In-depth explanation in IPM control methods, By: <https://www.naturesgoodguys.com/pages/integrated-pest-management>



Figure 5, Education for landscape industry employees in IPM. By: <https://www.pctonline.com/news/mccloud-pest-invasion-2019-recap/>

Client Description

Landscape Industry Employees in urban Cincinnati

- Landscapers, contractors, garden centers, horticulturists, arborists, lawn-care professionals, landscape architects
- Significant number of landscape industry employees in urban Cincinnati
- Landscape industry employees conduct IPM through design and control methods (cultural, mechanical, biological, chemical; tree/shrub, ornamental beds, turf, spring/fall cleanup in ornamental beds, mowing, pruning, and mulching)
- Landscape sites are accessible with box truck or truck and trailer (street, driveway and parking lot parking available)

Environmental Policy-Makers in urban Cincinnati

- Agricultural agencies, environmental protection agencies, regulatory bodies, extension services, researchers, and local, state, federal levels who contribute to setting IPM policies and guidelines
- Significant number of environmental policy-makers in urban Cincinnati
- Environmental policy-makers have an adverse effect on IPM through policy and guideline implementation that is used at the local, state and federal level



Figure 6 & 7, Landscape industry employees at work. By: <https://www.davey.com/commercial-services/>



Figure 8, State extension officer at work. By: <https://www.timesgazette.com/2024/08/12/osu-extension-opens-new-location/>



Figure 9, Environmental policy-makers at work. By: <https://www.ecosystemmarketplace.com/articles/navigating-the-turbulent-waters-of-us-environmental-policy/>

Major Project Elements

Education for Landscape Industry Employees in urban Cincinnati

- Describe the four major components of IPM (cultural control, mechanical control, biological control, and chemical control) and explain why these components are important in the landscape
- Describe an outline of an introductory IPM program that can be used by landscape industry employees
- Describe how an introductory IPM program for landscape industry employees could be evolved into a state certification program (such as an Ohio Applicator's License)
- Explain the benefits that this program would have on the ecological health of urban Cincinnati
- Describe new and emerging advances in integrated pest management, and explain how those advances can be incorporated in to an IPM program for landscape industry employees moving forward

Education for Environmental policy-makers in urban Cincinnati

- Describe the four major components of IPM (cultural control, mechanical control, biological control, and chemical control) and explain why these components are important in the landscape

- Describe how an introductory IPM program for landscape industry employees could be evolved into a state certification program (such as an Ohio Applicator's License)
- Describe advantages and disadvantages of an IPM program in urban Cincinnati
- Explain how policy and guideline implementation has an adverse effect on how IPM is conducted in urban Cincinnati and its effect on ecological health in urban Cincinnati
- Describe new and emerging advances in integrated pest management, and explain how those advances can be implemented in to policy for urban Cincinnati moving forward

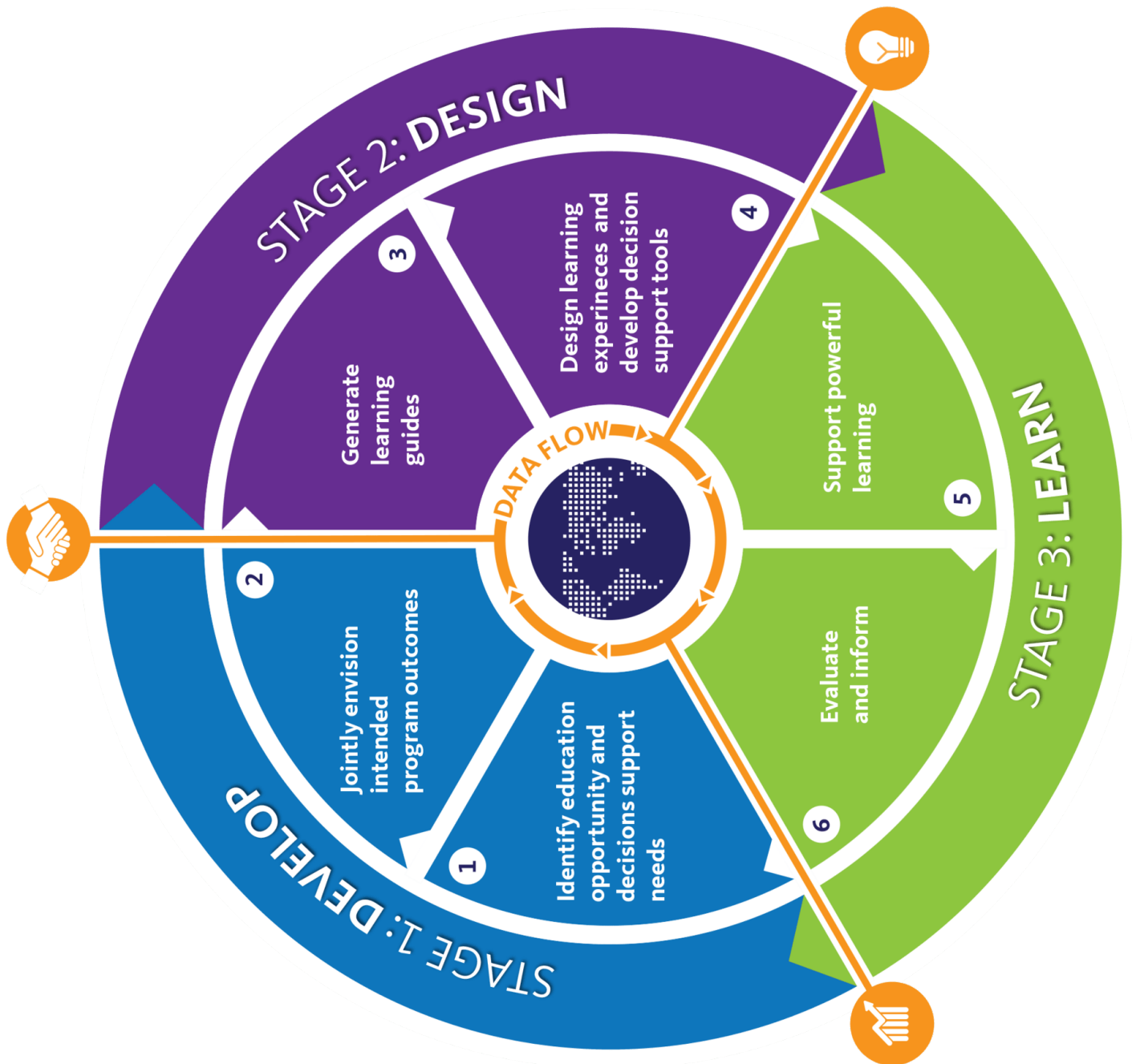


Figure 10, Six step education program on Integrated pest management. By: <https://extension.oregonstate.edu/catalog/pub/em-9328-increasing-reach-integrated-pest-management-through-community-partnerships>

<u>Pesticide-Based Pest Control</u>		<u>IPM Based Pest Control</u>	
Advantages	Disadvantages	Advantages	Disadvantages
Quick suppression of pests	Not long-term	Long-term control	It may take longer to see results
	Is not performed proactively	Can be proactive in pest control actions	Must establish thresholds
	Loss of natural controls Often get outbreaks of other pests	Reduces disruption of natural enemies	
	Extra work in cleanup	Pesticides used (only as a last resort)	Must have knowledge of pesticides and their effects on other organisms
Labor is only for spraying	Need a PCA recommendation.	Staff becomes more knowledgeable of pests and injury symptoms	Monitoring and scouting required Training is required to identify pests and natural enemies
Not much preparation or follow-up needed	Pesticide safety issues for applicators, public, animals.	Pest management is more organized	Must maintain a record-keeping system
		Less exposure to pesticides	

Figure 11, Table showing advantages and disadvantages of pesticide-based control versus IPM based control. By: <https://www.fountainvalley.gov/DocumentCenter/View/84/Integrated-Pest-Management-IPM-PDF?bidId=>

Education Information

Education for Landscape Industry Employees

- **The four major components of integrated pest management:**

Cultural Control- Physical practices involved in caring for plants, such as site and plant variety selection, creating habitats for beneficial insects, weeding, watering, nutrition management, sanitation, ect.

Mechanical Control- The physical removal or exclusion of pests using devices or methods such as traps, barriers, handpicking, pruning and mowing

Biological Control- The practice of using natural enemies such as predator insects, parasitic insects, nematodes and pathogens (ex. *Bacillus thuringiensis*) to control pest populations in the landscape

Chemical Control- the strategic and limited use of pesticides (made up of herbicides, insecticides, fungicides, miticides, ect.) as a last resort. This practice should only be used when necessary to control pest and disease problems that are out of control to the point that the other three control have become inefficient.

Outline of an introductory IPM program

(Kuhns, 2011)

1. Choose Plants Wisely

Select plants that are suited to the conditions in your landscape. For instance, if the soil is acidic, choose plants that prefer acid conditions. If most of the area is shaded, then you need plants that prefer shade. Plants placed in the wrong location will

not thrive and will be susceptible to many problems in the future. Select plant cultivars that are known to be less susceptible to insects, mites, and diseases. Also, consider growing plants that are native to your area, or native to an area with similar growing conditions.

2. Plant with Care

Help plants get a good start by installing them correctly. Mistakes made when planting or when applying mulch can result in weakened plants that are prone to problems.

3. Promote Plant Health

Healthy, vigorous plants are less vulnerable to damage caused by insects, mites, and diseases. Provide the best growing conditions by testing the pH and nutrient level of your soil, preparing soil well before planting, and then using fertilizers only as needed. Water plants regularly until they become established. Use mulches correctly and follow proper pruning recommendations.

4. Keep Plants Well Groomed

Debris that builds up in the landscape may harbor pests and plant diseases. Remove dead or dying plants. Rake and remove leaves that drop off plants. If a branch is broken or diseased, prune it. Use organic mulches that have been composted properly. Apply a layer no deeper than two or three inches, making sure the mulch does not touch the trunk or main stem of the plant.

5. Monitor Pests

Inspect plants regularly for insects, mites, diseases, or any unusual changes in appearance that might indicate a problem. Accurate identification of the cause is essential for evaluating the situation and

determining what, if any, management tactics are needed. Be aware that if a pest shows up, natural enemies that prey on it often appear as well. To monitor the health of plants in a landscape, you also must be able to recognize these beneficial insects. You may need to tolerate some plant injury before populations of beneficial insects and mites build up enough to keep a pest in check.



Source: PBL

Figure 12, In-depth process of an IPM program showing how all parts work together. By: https://www.researchgate.net/figure/Main-steps-of-integrated-pest-management_fig1_337632341



Figure 13, Example of a monitoring method used in IPM. By: <https://cpe.rutgers.edu/landscape/basics-of-integrated-pest-management>

The benefits of an Integrated Pest Management program on ecological health in urban Cincinnati are as follows;

(County of Santa Clara, 2025)

- *Promotes sound structures and healthy plants.*
- *Promotes sustainable bio-based pest management alternatives.*
- *Reduces environmental risk associated with pest management by encouraging the adoption of natural controls.*
- *Reduces the potential for air and ground water contamination by a reduction of chemical controls/ using pesticides only as a last resort.*
- *Protects non-target species through reduced impact of pest management activities by mitigating chemical drift, and chemical runoff caused by pesticides.*
- *Reduces the need for pesticides by using natural pest management methods such as cultural, and biological controls*
- *Reduces or eliminates issues related to pesticide residue*
- *Reduces or eliminates re-entry interval restrictions by a reduction of chemical controls in turf.*

- *Decreases worker, tenant and public exposure to pesticides by reducing reliance on chemical controls and promoting natural controls.*
- *Alleviates public concern about pest and pesticide-related practices.*
- *Maintains or increases the cost-effectiveness of a pest management program.*

BENEFITS OF USING AN IPM PROGRAM:

- Possible reduced costs
- Possible higher yields
- Less negative environmental impact
- Reduced chances for developing resistance




Figure 14, Some benefits of conducting an IPM program. By: <https://grow.ifa.coop/agronomy/integrated-pest-management>

Education for Environmental Policy-Makers

Environmental-policy makers are an important part of integrated pest management because they create and implement policies that affect how IPM is conducted in the landscape.

Environmental-policy makers need to be educated on IPM strategies in order to make responsible decisions and create flexible policies in order for those strategies to be effective.

- An introductory IPM program will be updated into a state certification program using the same methods as the Ohio Applicator’s Licensing program. In the Ohio applicator program, differentiated learning sections are broken down

into categories. These categories each have their own manual that can be studied in order to gain knowledge on the individual category.

- There is an online platform through the Ohio State Extension office where these manuals can be purchased. Once studying has concluded, a separate section in the website allows for registration of an application exam. The website has all dates/times and sites where the exams will be administered. The exam is registered for, taken and if the exam has been completed with a grade of 70% or higher, that person will become a licensed applicator for spraying restricted-use pesticides. A license will be received in the mail. Presently, a \$35 dollar licensing fee is due once a year, by October 1 (planthealthrenewal.agri.ohio.gov). In addition, every 3 years, 5 hours of advancement learning CEU's are to be completed and turned in to the Ohio Department of Agriculture.
- If this requirement is not met, the license will become void and the exam will have to be readministered in order to become licensed again. This method is a simple, organized way to gain knowledge and a required license before using a program that could have negative effects on ecological health in the landscape. This method would be an effective way that an IPM program could be administered, through the state, in a safe and responsible way to teach the required knowledge to landscape industry employees before they could ever practice IPM in the field.

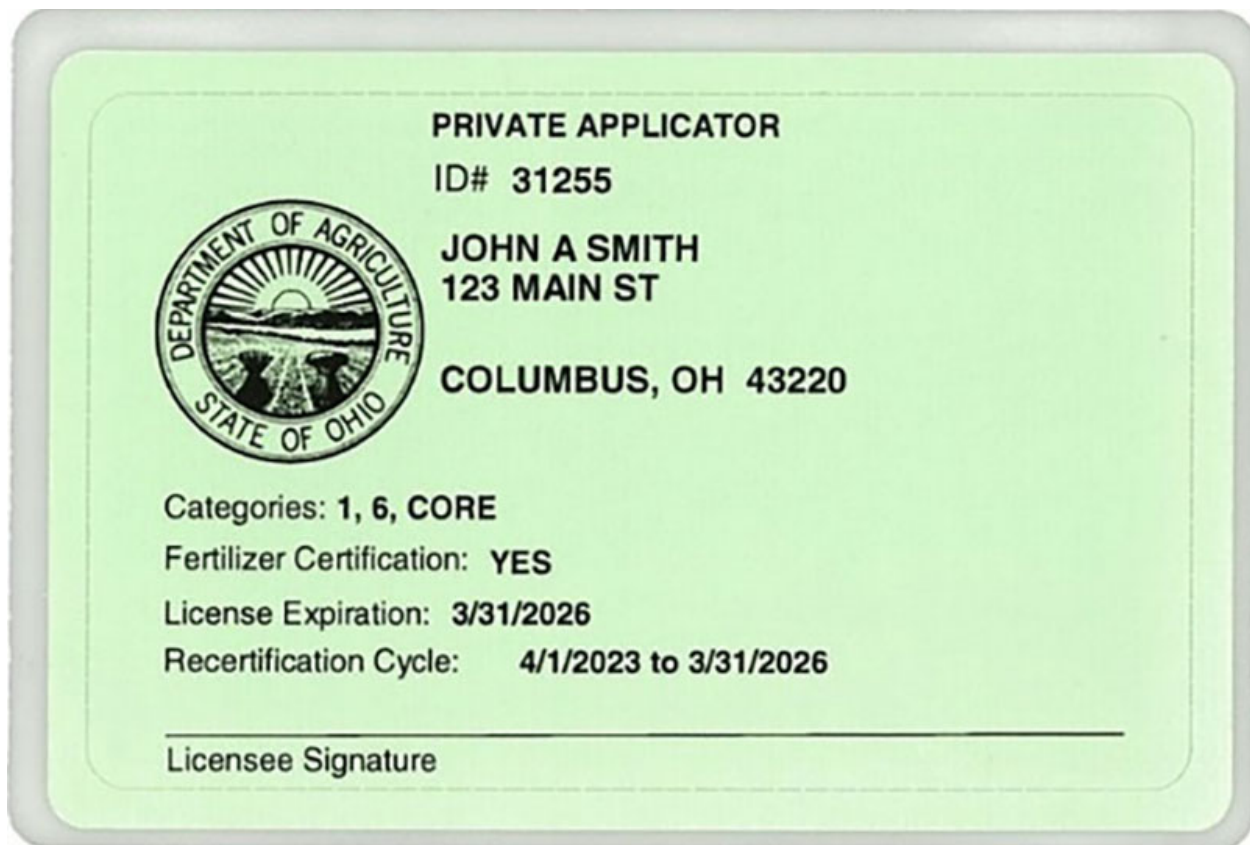


Figure 15, Example of an Ohio applicator's license. By: <https://ohioline.osu.edu/factsheet/anr-0141>

- Inflexible policy and guideline implementation by environmental policy-makers can negatively impact IPM by overly restricting the available pest control methods. This can lead to an over reliance on chemical controls when non-chemical controls might be more effective. This over reliance can lead to environmental harm and the promotion of pest resistance if not managed efficiently. Guidelines can become inflexible and disrupt the ability to adapt IPM strategies to specific local conditions and pest dynamics, ultimately leading to reduction in effectiveness of the overall pest management program.

- **New and emerging advances in IPM that have the potential to be implemented in to policy;**

(Baxter, 2025)

1. *Addressing critical Integrated Pest Management (IPM) challenges.*
2. *Integrating diverse disciplines and sectors, such as biopesticides, computational/AI technologies, engineering, health, food security, climate change and environmental sciences.*
3. *Enhancing industry management in IPM research and applications.*
4. *Facilitating the formation of collaborative networks that can pursue funding opportunities. (e.g., Innovative grants)*
5. *Promoting partnerships with reciprocal benefits.*
6. *Showcasing new products and strategies for effective IPM.*

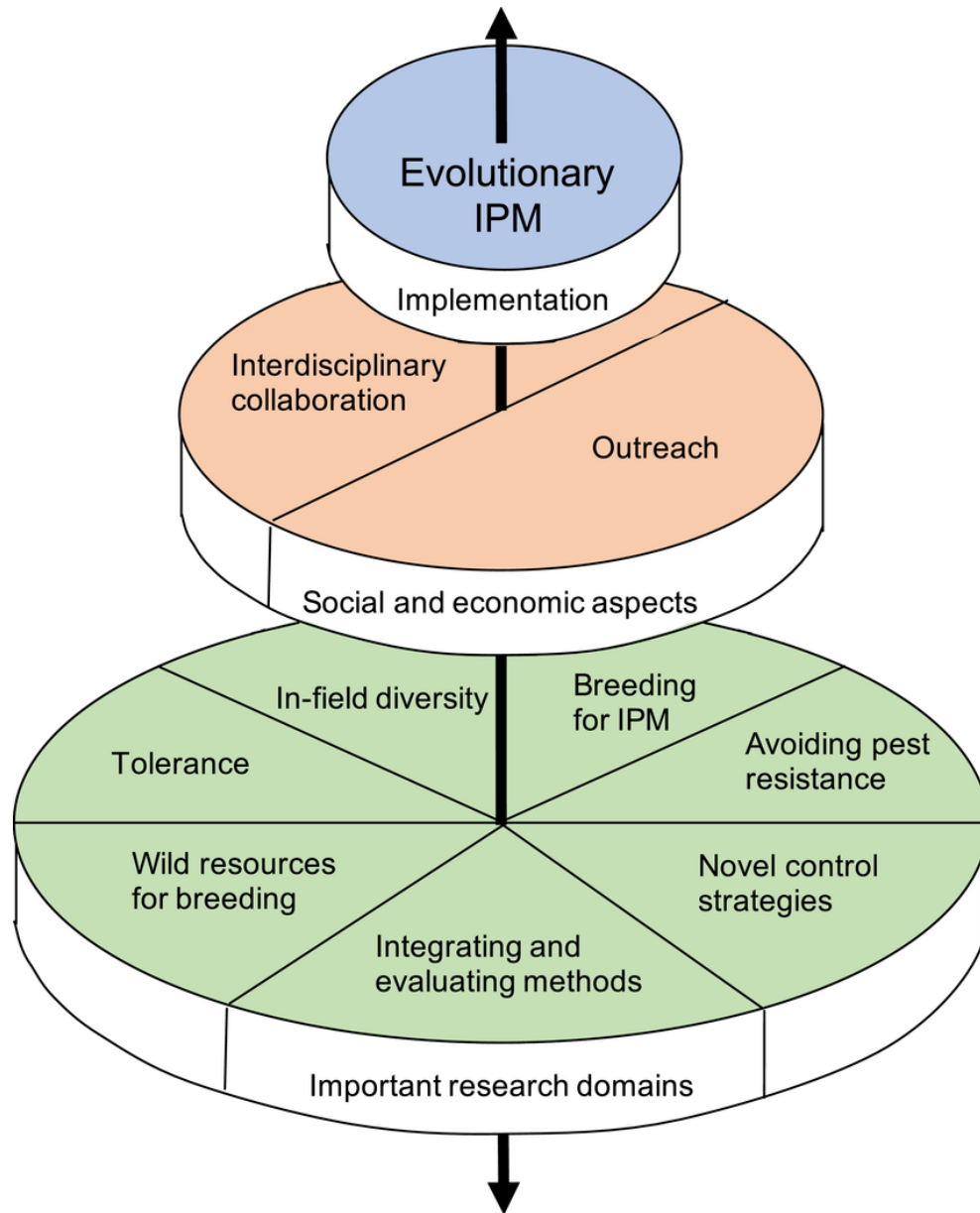


Figure 16, Tiered approach showing different sectors and advancement of evolutionary IPM. By: <https://www.researchgate.net/figure/The-concept-of-Evolutionary-Integrated-Pest-Management-as-presented-in-the-current-paper-fig2-343012072>

- Advances in the last two years can be implemented in to policy for urban Cincinnati from collaboration between local/state government and the state extension office. The extension office has the knowledge because IPM is an integral part of what they do. However, state extension needs the funding and support from local/state government to be able to carry out these initiatives.



Figure 17, State government working on environmental policy. By: <https://highlandcountypress.com/commissioners-accept-bids-osu-extension-office-new-market-road-paving-project#gsc.tab=0>

Education Summary

In the spring of 2025, education in integrated pest management is an under-utilized method for both landscape industry employees and environmental policy-makers. IPM is a critical factor in ecological health in urban Cincinnati, therefore, change must be implemented.

Knowledge of the four main components of IPM and an introductory IPM program are integral for success in the landscape industry.

Additionally, education for environmental policy-makers by the state extension office is paramount. Responsible, ethical and efficient policies/ guidelines cannot be implemented without intensive and adequate education in local/state government.

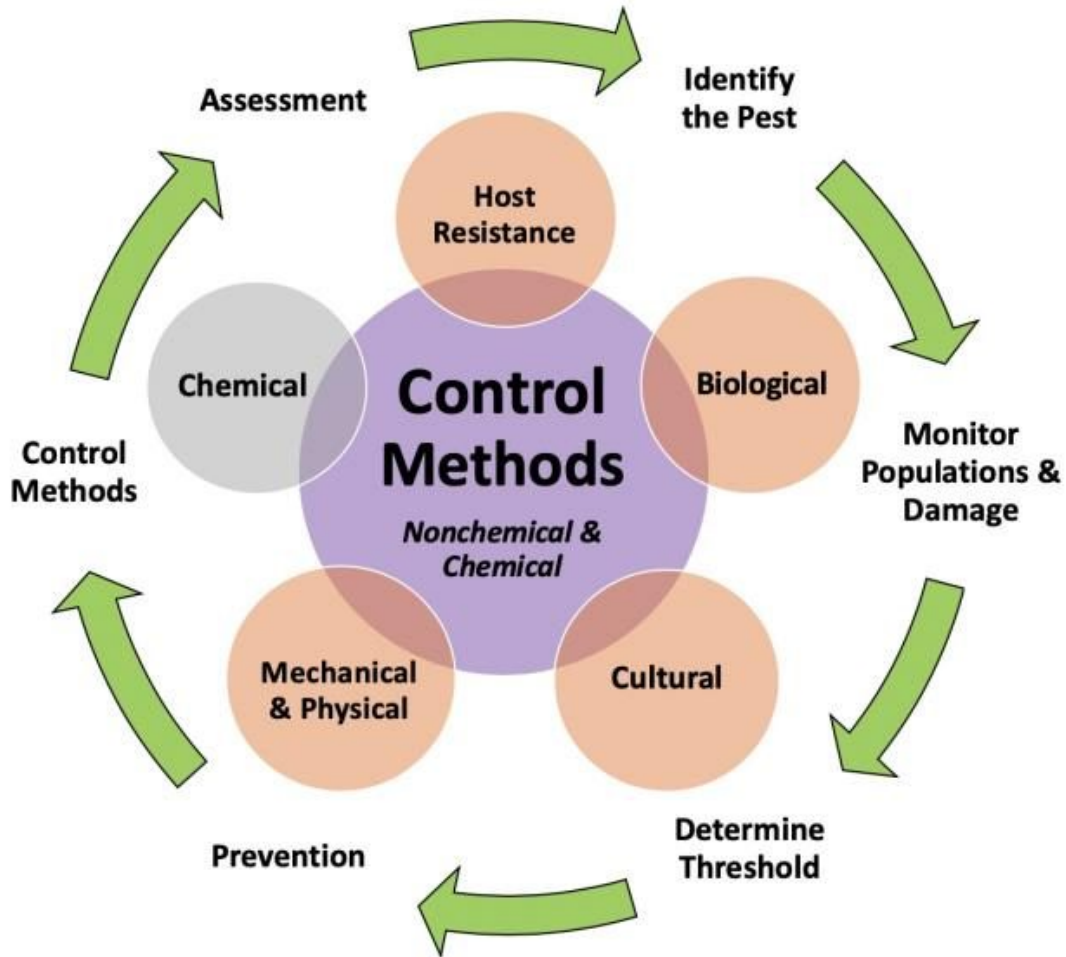


Figure 18, Shows all the necessary steps of control methods that make up IPM. By: <https://www.pubs.ext.vt.edu/ENTO/ENTO-365/ENTO-365.html>



Figure 19, Shows control methods and all aspects that make up an IPM program. By: https://www.bizybeeexterminators.com/blog/what-is-integrated-pest-management/?post_type=blog_post

Literature Review and Case Studies

Integrated Pest Management for urban landscapes:

This study focuses on the development and implementation of integrated pest management strategies, specifically for urban landscapes, and focuses primarily on woody ornamentals and turf. It is emphasized that rapid evolution of IPM is occurring in the United States due to a diversity of plant materials and their associated pests in the urban landscape.

The study highlights that pest-resistant and plant-based management strategies are being developed to reduce reliance on traditional chemical control methods and support mitigation of environmental/health risks associated with pesticide use. Incorporating biological control and host plant resistance in IPM programs is being emphasized in order to conserve natural enemies, increase awareness for biological and cultural control methods and show the importance of sustainable practices and an increase in IPM knowledge.

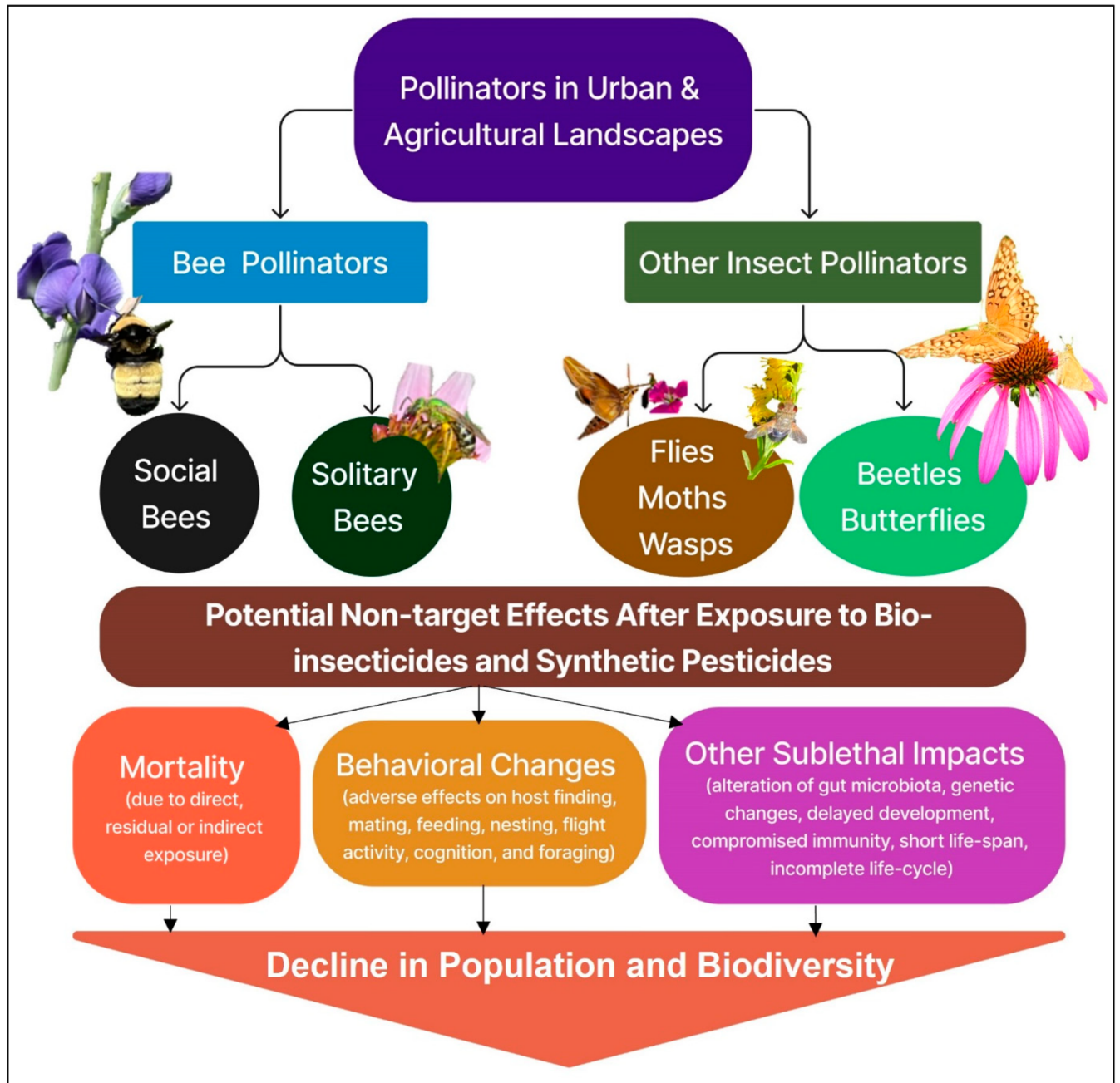


Figure 20, Graphic showing decline of urban pollinators due to pesticide use. By: <https://www.mdpi.com/2813-3145/3/1/7>

Developing and Delivering a Needs-Based Integrated Pest Management Program for Public School Grounds Employees:

This study utilized a focus group and survey to identify high-priority training topics, including landscape and turf weed management, hardscape weed management, building a low-maintenance landscape, and maximizing low impact pesticides. Site visits were conducted to confirm the severity of these issues and determine additional IPM related topics to add into future training events.

Four training events were conducted in two school districts with a total of 66 employees from 15 out of 23 school districts in the Portland Oregon area. Results showed that the majority of participants felt the training improved their knowledge of turf and landscape IPM and most attendees stated that they planned to decrease their pesticide use by applying the skills learned from the training.

The study highlights the importance of offering specific training on non-chemical methods used in IPM. By incorporating topics such as weed management and pest control, the research aimed to provide practical training to improve non-chemical IPM methods for public school grounds employees in the Portland Oregon area.

Do you feel that the IPM Practices for Metro Area Public Schools training improved your knowledge in the following categories?					
Question	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Landscape weed identification	4	20	2	1	0
Turf weed identification	3	20	3	1	0
Hardscape weed identification	3	18	5	1	0

Do you feel that the IPM Practices for Metro Area Public Schools training improved your knowledge in the following categories?

Question	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Landscape weed management	6	17	3	1	0
Turf weed management	5	21	1	0	0
Hardscape weed management	5	18	3	1	0
Landscape weed prevention	5	17	4	1	0
Turf weed prevention	5	18	4	0	0
Hardscape weed prevention	6	13	7	1	0
Herbicide selection for landscape weeds	5	17	4	1	0
Herbicide selection for turf weeds	4	17	5	1	0
Herbicide selection for hardscape weeds	5	16	5	1	0
Herbicide alternative control methods for weeds in the landscape	6	17	3	1	0

Figure 21, Chart showing results on training for public school grounds workers. By: <https://acsess.onlinelibrary.wiley.com/doi/full/10.4195/nse2015.0017>

City of Fountain Valley Integrated Pest Management (IPM) Policy and Guidelines Implementation:

This document outlines the Integrated Pest Management policy and implementation guidelines for the City of Fountain Valley (California). Since 1970, there has been an over-reliance on chemical controls for pest management, which has led to an increase in pest resistance and environmental issues. This document emphasizes that environmental policy-makers are now shifting stance, and moving towards an integrated-approach that combines very limited pesticide use with more environmentally-friendly IPM techniques such as cultural, mechanical and biological control methods.

The policy encourages these control methods over sole use of pesticides. The goal is to keep pest populations at tolerable levels, not eliminate them completely. Good prevention practices such as using resistant plant varieties, proper cultural controls, and sanitation are critical to reducing pest population increase. A combination of cultural/mechanical/biological control methods are utilized with pesticides as a last resort.

This policy has an IPM coordinator and outlines required procedures across site preparation, water management, fertilization, pruning, monitoring and selection of non-chemical control methods for insects, weeds, and diseases in the landscape. The overall goal of this policy is implementation of an IPM program that prevents and suppresses pest problems through non-chemical methods with minimal impact on health, environment, and non-target organisms.

Advantages and Disadvantages of IPM	
Advantages	Disadvantages
Reduces chemicals being used	Individual using IPM must be educated about the options
May reduce number of pesticide resistant insects	Takes more time to initiate than simply “spraying for insects”
Only uses chemicals as last resort	Must be closely monitored for best results
Long-term benefits (lower cost for chemicals, better for the environment and human health)	Natural enemies of pests may become pests themselves

Figure 22, Advantages and disadvantages of IPM in the landscape. By: <https://www.slideshare.net/slideshow/integrated-pest-management-a-technique-through-ffs-by-allah-dad-khan/48252308>

Case Study Summary

Integrated Pest Management for urban landscapes:

The research study on integrated pest management strategies for urban landscapes, emphasizes the importance of increasing awareness in the use of natural control methods such as cultural, and biological control in order to mitigate environmental/ health risks caused by traditional chemical control methods (pesticides). This study is a notable goal of this project because it highlights the importance of education in IPM natural control methods in order to mitigate the use of chemical controls and reduce the adverse effects that chemical controls can cause in the urban landscape as well as the health to beneficial insects and people.

Developing and Delivering a Needs-Based Integrated Pest Management Program for Public School Grounds Employees:

The research study on developing and delivering an IPM program for public school grounds employees is an important goal of this project because it shows a real-life example of how education on specific aspects of IPM can be addressed and delivered, and the positive results that can be achieved from that education. “The results showed that the majority of participants felt that the training improved their knowledge and stated that they planned to decrease their pesticide use by applying the skills learned from the training”. This study shows that education on IPM can decrease pesticide use and support an environmentally-friendly and economical program for the urban landscape as well as a reduction in adverse effects on non-target insects and people.

City of Fountain Valley IPM Policy and Guidelines
Implementation:

The City of Fountain Valley IPM policy and guidelines implementation shows and describes a successful IPM program that has been implemented by an actual city and the document highlights the positive effects that an IPM program can have on the ecological health of an urban landscape when used responsibly. An important goal of this project is to show that education on IPM can have positive effects on ecological health in the urban landscape and that an IPM program can be created and distributed to landscape industry employees and environmental policy-makers in order to achieve that initiative. This document is an effective example of how that initiative can be achieved.

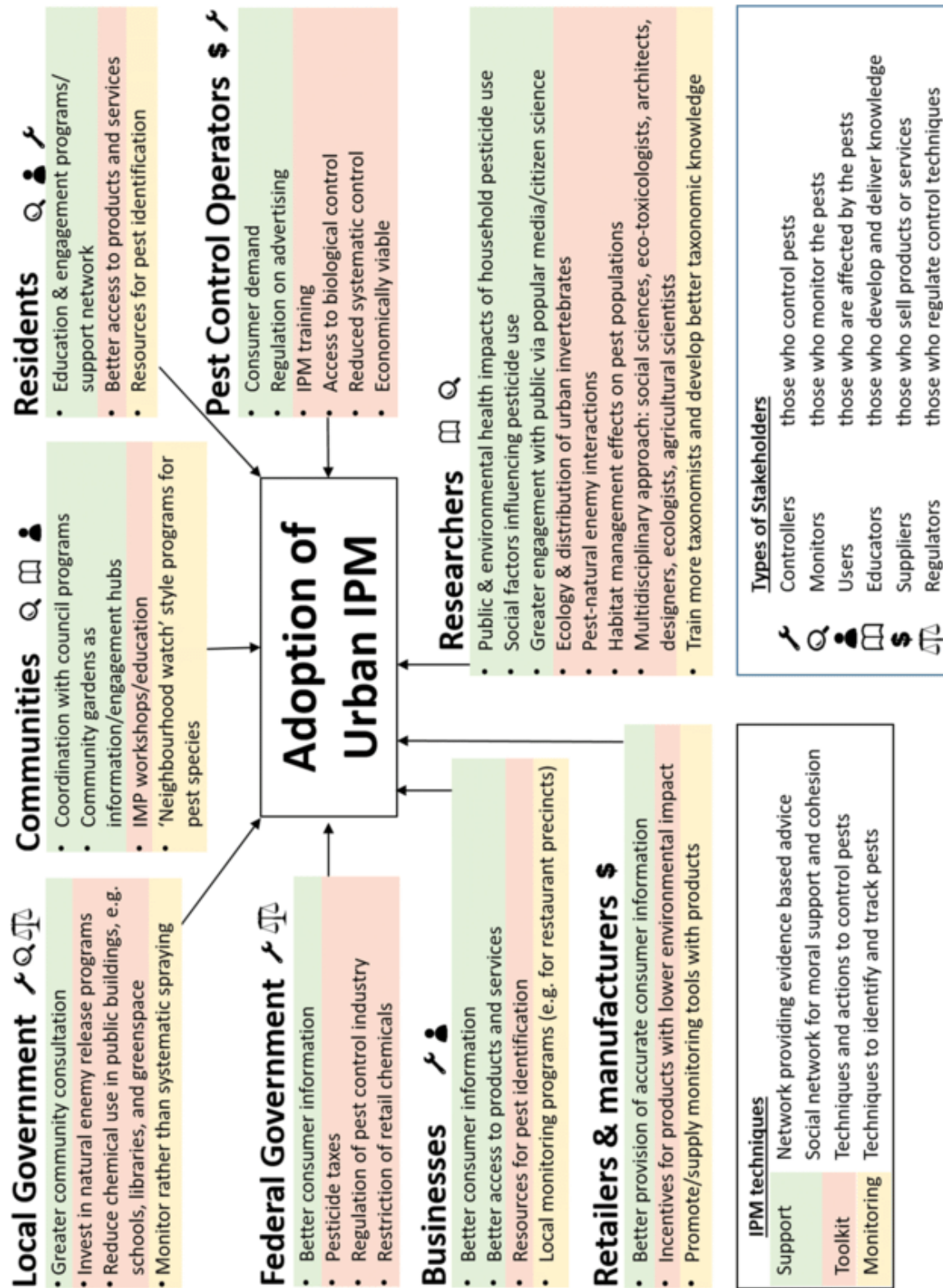


Figure 23, strategies and tools that can be used to aid policy-makers in adopting responsible IPM strategies. By: https://www.researchgate.net/figure/Strategies-and-tools-to-aid-the-adoption-of-IPM-by-urban-stakeholders-The-stakeholders_fig2_330756540

Historical Context of Integrated Pest Management

- 1940's: Entomologists in California developed introductory "supervised insect control"
- 1950's: Entomologists discovered that insects were developing resistance to pesticides
- 1960's: Rachel Carson's *Silent Spring* alerted the public to the dangers of pesticide use
- 1972: President Richard Nixon first used the term "Integrated Pest Management" in a special message to congress
- 1979: President Jimmy Carter established the Federal Integrated Pest Management Coordinating Committee (FIPMCC)

Integrated Pest Management has been a part of society in the United States since 1965. After Rachel Carson's *Silent Spring* which alerted the government to the dangers of pesticides being used at that time, some change toward safer practices with pesticide formulation and use was enacted. However, up until the last 15 years, IPM strategy still relied heavily on pesticide use and, in some areas, still relies heavily on pesticide use today. However, in the last 3 years, there has been an intensive push toward minimizing pesticide use and using environmentally-friendly IPM practices such as cultural, mechanical, and biological controls in the landscape.

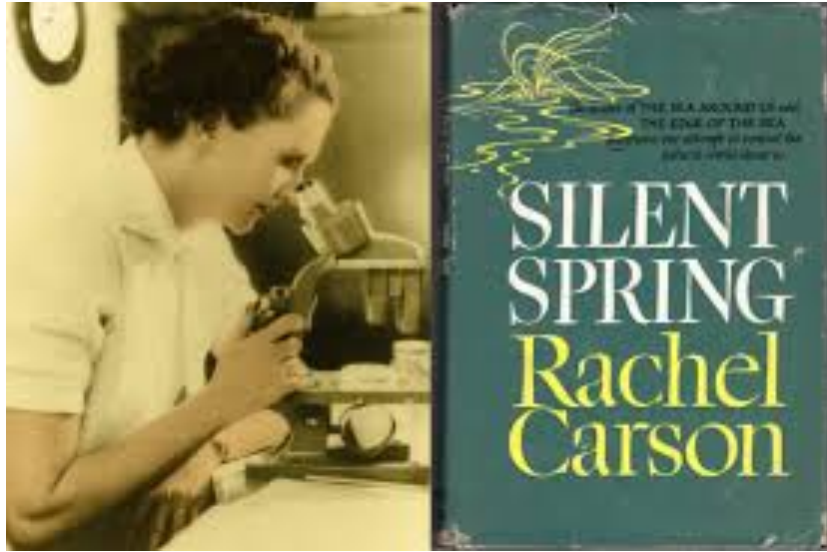


Figure 24, Rachel Carson and Rachel Carson's *Silent Spring*. By: <https://civileats.com/2022/10/19/after-60-years-silent-spring-is-still-changing-the-world/>



Figure 25, Drs. Perry Adkisson and Ray Smith, co-recipients of the 1997 World Food Prize, were among the first to note the harmful environmental and economic effects of indiscriminate synthetic chemical pesticide use. By: <https://landscapeipm.tamu.edu/what-is-ipm/history-of-ipm/>

Project Goals

- Explain what Integrated Pest Management (IPM) is and why it is an important program to use over traditional chemical control methods.
- Provide education in current IPM strategies for landscape industry employees and environmental policy-makers.
- Provide education on new and emerging advances in IPM that have the potential to be implemented into policy.
- Explain the advantages and disadvantages of using IPM in the landscape.
- Create an outline of an introductory IPM program that can be distributed to and used by landscape industry employees and environmental policy-makers.
- Discuss key moments in the history of IPM and the advancements of IPM since the 1960's.
- Explain how education and knowledge in IPM strategies can improve the ecological health in urban Cincinnati.



Figure 26, image showing ecological health in urban Cincinnati. By: <https://www.keepcincinnatibeautiful.org/greenspace>

Project Requirements

Clients

- Landscape Industry Employees
- Environmental Policy-Makers

Types of programs needed for education

- Conferences (online or in-person)
- Expositions (online or in-person)
- Workshops (online or in-person)
- Seminars (in-person)
- Webinars (online)
- Self-paced online courses
- Ohio Certification Program (online or in-person/ will require recertification every 3 years with 5 hours of continuous education)

All programs will require quizzes or testing of some kind

Organizations that will require education

Landscape Industry Employees:

- The American Society of Landscape Architects
- Professional Grounds Management Society
- The National Association of Landscape Professionals
- The International Society of Arboriculture
- The American Horticultural Society
- Entomological Society of America
- American Phytopathological Society

Environmental Policy-makers:

- Ohio State Extension Agency
- Ohio Department of Agriculture
- Ohio Department of Natural Resources
- Ohio Environmental Protection Agency
- Ohio Pest Management Association
- United State Department of Agriculture

There are three areas of focus to the programs:

- The first area of the programs is focused on ***residential sites***. These programs require 3 sections; introductory, intermediate, and advanced learning. These sections are available in all listed program types.
- The second area of the programs is focused on ***urban forestry***. These programs require 3 sections; introductory, intermediate, and advanced learning. These sections are available in all listed program types.
- The third area of the programs is focused on ***commercial sites***. These programs require 3 sections; introductory, intermediate, and advanced learning. These sections are available in all listed program types.



Figure 28, Image of a residential site. By: <https://www.homes.com/local-guide/cincinnati-oh/pleasant-ridge-neighborhood/>



Figure 29, Image of urban forestry. By: <https://cnr.ncsu.edu/news/2022/04/5-benefits-of-urban-forests/>



Figure 30, Image of a commercial site. By: <https://wiselandscapingcompany.com/our-services/landscape-enhancements/>

Solutions

Introductory outline of an IPM program for landscape industry employees and environmental policy-makers in urban Cincinnati:

- Identify attributes of healthy plants
- Describe plant stresses
- Explain how planting location influences plant health
- Outline the steps to the diagnostic process
- Build a graphic model that describes the diagnostic process
- Define the term weed
- Explain how life cycle impacts management options
 - Annual/biannual/perennial life cycles
 - Describe winter and summer season weed biology
- Provide an overview of types (broadleaf/grasses/sedges)
- Describe transmission techniques
- Define IPM
- Examples of IPM insect management tools (with examples/descriptions)
 - Cultural
 - Mechanical
 - Biological
- IPM tool overview
 - Chemical controls (describe at least four different modes of action)
 - Oils
 - Soaps
 - Insecticides
 - Miticides

- Provide overview of plant pests (include information about pest biology)
 - Insects
 - Mites
 - Mollusks
- Types of feeding/common insects/symptoms/signs
 - Chewing
 - Piercing/sucking
- Impact of insect lifecycle and how it relates to management
- Chemical resistant pest management (discuss IRAC)
 - Create a table that illustrates situations that describe each side of the triangle
- Overview of plant pathogens (include biological information for each)
 - Viruses
 - Bacteria
 - Fungi
- Plant parts affected by diseases (create a table for each category)
 - Foliar diseases
 - Stem diseases
 - Root diseases
- Contrast the concept of control versus management
 - Contrast manageable versus non manageable disease (provide examples)
- Contrast abiotic (stress) with biotic (disease) plant health issues
- Create a visual table with common environmental, insect and disease symptoms
- Labeling and its relation to law
- Link to state law (Ohio Revised Code 921.01 CC)

- Highlight the ORC four step pest management plan
- Spraying techniques and strategies
 - Cover versus targeted sprays
 - Contact versus systemic sprays
- Contrast
 - Preventative versus curative
 - Protectant versus systemic
- Provide detailed information about:
 - Aesthetic versus affecting health of the plant
 - Manageable versus unmanageable
 - Treatment thresholds
 - Preventative versus reactive sprays
 - Targeted treatments versus broadcast sprays
 - Application timing
 - Examples of when to do nothing

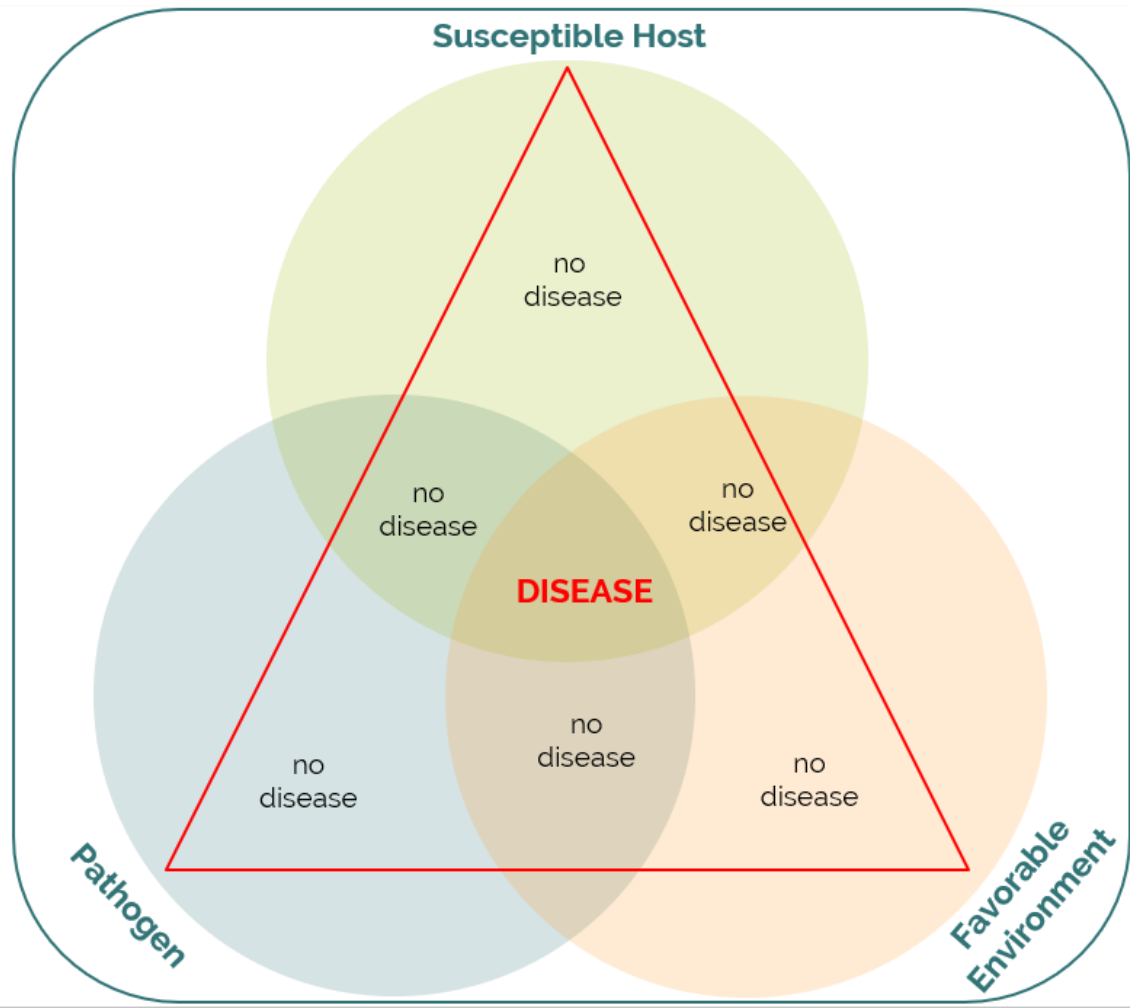


Figure 31, Fundamentals of the disease triangle. By:

<https://www.linkedin.com/pulse/understanding-plant-disease-triangle-cubed-labs>

In Integrated Pest Management, the “disease triangle” illustrates that a plant disease requires a susceptible host, an active pathogen, and a favorable environment in order to develop. If any of these factors are missing, disease will not occur.

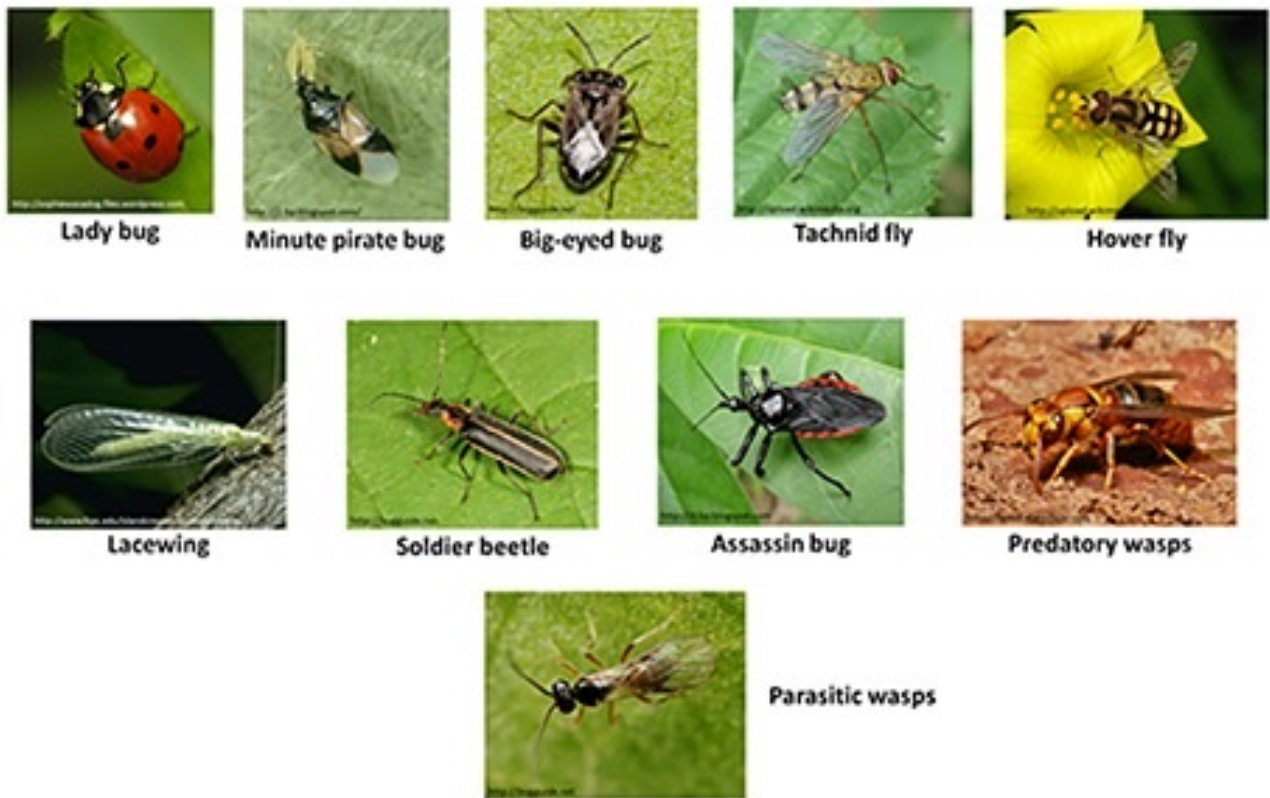


Figure 32, Examples of beneficial insects in the landscape. By: <https://ipm.missouri.edu/MPG/2015/12/Increasing-beneficial-insects-for-enhanced-pollination-and-biological-control-using-insectary-plants/>

Common Garden Pests

garden366.com



Figure 33, Examples of common landscape pests. By:
<http://www.bloomingdalegardenclub.org/event/july-2018-pests-problems-on-the-home-landscape/>

Client Description:

- Landscape industry employees in urban Cincinnati: garden centers, horticulturists, arborists, lawn-care professionals, landscape architects.
- Significant number of landscape industry employees in urban Cincinnati.
- Landscape industry employees conduct IPM through design and control methods (cultural, mechanical, biological, chemical, tree/trunk, ornamental beds, turf, spring/fall cleanup in parking areas).
- Landscape sites are accessible with box truck or truck and trailer (street, driveway and parking lot available).

Environmental Policy-Makers in urban Cincinnati:

- Local, state, and federal agencies, regulatory bodies, extension services, researchers, and local, state, federal levels who contribute to setting IPM policies and guidelines.
- Significant number of environmental policy-makers in urban Cincinnati.
- Environmental policy-makers have an adverse effect on IPM through policy and guideline implementation that is used at the local, state and federal level.

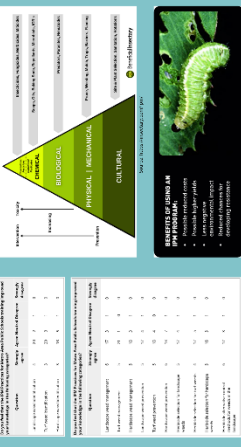


Developing and Delivering a Needs-Based Integrated Pest Management Program for Public School Grounds Employees:

A research group and advisory to identify high-visibility training topics, including landscape and turf weed management, landscape weed management, building a low maintenance landscape, and maintaining low impact pesticides. Site visits were conducted to confirm the severity of those issues and determine additional IPM related topics to add into future training events.

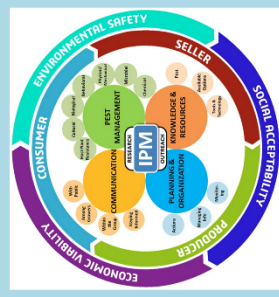
Four training events were conducted in two school districts with a total of 68 employees from 15 out of 23 school districts in the Portland Oregon area. Results showed that the majority of participants felt the training improved their knowledge of turf and landscape IPM and most attendees stated that they planned to decrease their pesticide use by applying the skills learned from the training.

The study highlights the importance of offering specific training on non-chemical methods used in IPM. By incorporating topics such as weed management and pest control, the research aimed to provide practical training to improve non-chemical IPM methods for public school grounds employees in the Portland Oregon area.



Quinn Leibold
Faculty Advisor, Professor Steve Famulari Gds.
Hericulture Capstone
Spring 2025

How can the use of Integrated Pest Management Strategies be used to educate Landscape Industry Policy-Makers on the benefits IPM has on ecological health in urban Cincinnati?



Abstract:

Integrated Pest Management (IPM) is a sustainable decision-making process that uses information on pest biology, environmental data, and technology to manage pest damage in a way that minimizes both economic costs and risks to people, property and the environment. IPM uses four major components, cultural control, mechanical control, biological control, and chemical control in order to support prevention of insect pest and pathogen problems in the landscape.

Landscape industry employees (landscapers, contractors, garden centers, horticulturists, arborists, lawn care professionals, landscape architects) and environmental policy-makers need education on the four components of integrated pest management in order to conserve beneficial insects in the landscape, make improvements to the ecological health in urban Cincinnati and to make quick, insightful, and smart decisions when it comes to prevention and control of insect pest and pathogen problems. This project explains the educational strategies that landscape industry employees need in order to fulfill this initiative.

Educational program in IPM for Landscape Industry Employees and Environmental Policy-Makers in urban Cincinnati

Program Requirements:

- Types of programs needed for education:
 - Conferences (online or in-person)
 - Expositions (online or in-person)
 - Workshops (online or in-person)
 - Seminars (in-person)
 - Webinars (online)
 - Online courses
 - Ohio Certification Program (online or in-person) will require recertification every 3 years with 5 hours of continuous education
- All programs will require quizzes or testing

Organizations that will require education:

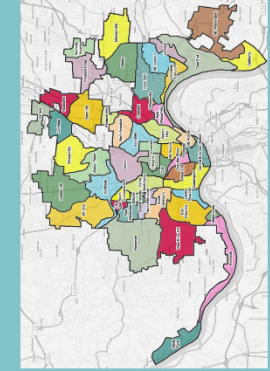
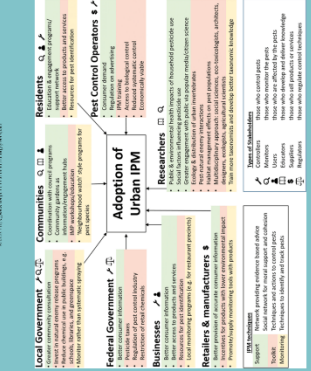
- Landscape Industry Employees:**
 - The American Society of Landscape Architects
 - The International Society of Arboriculture
 - The National Association of Landscape Professionals
 - The International Society of Arboriculture
 - The American Horticultural Society
 - Entomological Society of America
 - American Phytopathological Society
- Environmental Policy-makers:**
 - Ohio State Extension Agency
 - Department of Agricultural Resources
 - Ohio Department of Natural Resources
 - Ohio Environmental Protection Agency
 - Ohio Pest Management Association
 - United States Department of Agriculture

There are three areas of focus to the programs:

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- The third area of the programs is focused on commercial sites. These programs require 3 sections, introductory, intermediate, and advanced learning. These sections are available in all listed program types.

Citations:

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Video Summary

A video has been created that covers an outline of the introductory lesson plan from pages 49-51. The lesson plan describes why education in IPM is important to landscape industry employees and environmental policy-makers in urban Cincinnati, the educational programs that are available to landscape industry employees and environmental policy-makers in urban Cincinnati, coverage of the different horticultural aspects of integrated pest management, and other closely related horticultural aspects that are essential to learn in order for integrated pest management to be understood clearly.



City of Fountain Valley IPM Policy and Guidelines
Implementation:

<https://www.fountainvalley.gov/DocumentCenter/View/84/Integrated-Pest-Management-IPM-PDF?bidId=>

This link goes to policy and guideline implementation of an actual IPM plan that is used by the city of Fountain Valley, California. This IPM plan shows a real-life example of how a city can use education in IPM in order to manage the landscape responsibly and mitigate overuse of chemical controls for weed, disease and insect pest control.

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