

Aphids, Aphids, Everywhere!

Lesson 4

“Aphids are destroying the plants in the greenhouse! What do I do now?” First, it must be determined if action is necessary and if so, what actions should be taken? What are the costs and benefits of managing the pest versus doing nothing? In this activity, students will research, recommend, and possibly implement different management tactics if the tactics are found to be warranted and cost effective. Focus will be directed at using biological control (biocontrol) options to address current pest problems in the greenhouse.

Suggested Level(s):

Grades 9-12

Subject(s):

Environment & Ecology; Science & Technology; Reading, Writing, Speaking & Listening; Economics

Standards:

Environment & Ecology

4.5 Integrated Pest Management

Science & Technology

3.3 Biological Sciences

Reading, Writing, Speaking &

Listening

1.8 Research

Economics

6.3 Scarcity and Choice

Skills:

Researching, Problem solving,

Discussing, Analyzing.

Synthesizing & Creating

Technology Connection:

Internet Resources

Materials:

Internet access

Resource books & materials

Pencil/pen

Paper

Objective(s):

Students will

- explain the concept of economic (action) threshold
- research biocontrol options for specific greenhouse pests
- analyze the costs and benefits of using biocontrol options for pest management
- develop and present pest management recommendations for a specific pest
- observe outcomes of using biological control, if applicable

Assessment Opportunities:

Using the information presented by all of the groups, have each student individually synthesize the information and create a “management plan” for the greenhouse. Possible items to include for each pest:

- Name of pest
- Cultural and physical tactics available for management
- Biocontrol options available for management
 - Costs
 - Benefits
 - Schedule for using biocontrols
- Recommendations for managing the specific pest
 - If no recommendations at this time, indicate changes that may lead to action being taken and list those actions (ex. aphid population must increase to [# of aphids] per plant before ladybird beetles should be released)

Background:

Before a grower decides to take action for a pest problem, he/she needs to make sure it is an economically sound decision. Pests cause injury, physical harm, or destruction to crops regardless of the pest population level. But the damage sustained is dependent on the pest population. Damage is the monetary value loss of the crop because of the injury caused by pests. Depending on the pest species, a small population may be able to be tolerated. Figuring out at what point to employ a pest management action, the grower must ask two important questions, “How much financial loss is the pest causing?”

and “How much will it cost to control the pest?”¹

Growers lose profit when the value of the crop lost to the pest is greater than the cost to control the pest. Action needs to take place before this happens, but not so early that it's not cost effective. The concept of “Economic Injury Level (EIL)” can be used to help decide when the pest population level reaches an unacceptable level. The pest population density when the cost of controlling the pest is equal to the value of the crop lost is the EIL. However, by the time the EIL is reached it is too late to act. By the time supplies are gathered and applied, the pest population density will have had the chance to exceed the EIL and diminish the grower's profit.

The Economic Threshold (ET), or Action Threshold (AT), is the point where a decision about managing the pest needs to be made to ensure the pest population doesn't reach the EIL. The ET is the EIL minus a portion of the pest density to allow time for the grower to apply control measures. Both the ET and the EIL are expressed as the number of insects per given area, such as 5 aphids per leaf. The ET can vary due to the crop development stage, the value of the crop being grown, and the cost of control measures available. While EILs and ETs are not well established for greenhouses, over time with thorough monitoring records, a grower can determine the ETs specific for his/her given situation.

Economic value is not necessarily the only value to consider when making a decision of when and how to manage a pest problem. The aesthetic value of the crop may be important, especially when it relates to landscaping. When choosing a management strategy, other factors to consider include possible insect resistance, effect on worker/applicator health, proper disposal, and environmental issues such as water contamination. There is no “one, correct way” to manage a pest problem. Each grower following an IPM plan needs to weigh the cost and benefits of different management options and choose the safest, least-toxic, most effective method for the given situation.

Using biological controls, or biocontrols is one IPM tactic that significantly reduces the issues of toxicity, insect resistance, health concerns, disposal problems and water contamination. Biocontrol is the use of living organisms such as predators, parasitoids and pathogens to control pest problems in a variety of situations. The use of biocontrols requires involvement from the grower. He/she must understand the life cycles of the pest and biocontrol organisms, learn monitoring techniques, keep accurate records, properly time the release of biocontrols, and assess the population of pests and biocontrols. Not every pest has a biological control agent that can be used, and some are more practical in a field setting than a greenhouse. However, many greenhouse pests can be successfully managed using biocontrols. There are several suppliers of biocontrol organisms in the United State and they can instruct the grower in how to use the biocontrol organisms for the specific situation. The Association of Natural Biocontrol Producers, www.anbp.org (accessed on 6/19/12), provides an extensive list of producers and distributors of biological control organisms.

Reference:

¹Meyer, John R. “Economic Injury Level.” NC State University.

<http://www.cals.ncsu.edu/course/ent425/tutorial/economics.html> (accessed on 6/19/12)

Getting Ready:

1. Students should work with the same partners/groups that they had for Lesson 3. They should also use the same pest they were assigned in Lesson 3 for this lesson.
2. A history of the pesticides used in the greenhouse and when they were used should be available to all students. Pesticide use and residue can influence the success of biological control.

Doing the Activity:

1. As a class, discuss the concept of economic (action) threshold. Explain that in a greenhouse setting, it takes time to accurately determine the economic threshold for a specific pest. It is not a cut-and-dry answer either. It varies depending on the situation.
 - Hypothesize if current pest populations in the greenhouse warrant pest management action be taken at this time. If not, at what point should action be taken? (Ex. pest population reaches a certain size, economic threshold reach, damage to plants, etc.) Does crop age play a role in determining if action should be taken?

2. 🐞 Using data gathered in Lessons 2 & 3, each group should:
 - Use the Internet and other resources to research biological control options and other management options (excluding pesticides) for their specific pest. Include any information found about how and when to use the biocontrols. Are there any recommendations of pest population size and the use of the biocontrols?

3. As a group, analyze the costs and benefits of using biological controls to manage the specific pest. Items to consider include:
 - How much do the biocontrols cost? How much of a supply is needed for the greenhouse?
 - How are the biocontrols applied? Is additional equipment needed to apply them? If so, what is the cost of the equipment?
 - What type of schedule is required to apply the biocontrols? Is the schedule realistic and doable?
 - What is the history of pesticide applications in the greenhouse (supplied by teacher)? Is this compatible with using the biocontrols?
 - What are the benefits of using biocontrols?
 - Are there other any other cultural or physical controls that can be implemented that haven't been already?
 - What will it cost, in crop loss, if no control options are used? How does this compare to using the biocontrols? Consider short-term and long-term costs.

4. As a group, use the information gathered and data collected in the greenhouse to make a management recommendation for the assigned pest.
 - What cultural and physical tactics are recommended?
 - What biocontrol options are recommended? Costs? Benefits?
 - What is the current pest population?
 - Should biocontrols be implemented now? Why or why not? If not, when (at what pest population level)?

5. Have each group present their findings and recommendations to the class. A hard copy of the information from each group should be made available to everyone in the class.

6. If biocontrols are warranted and it is financially able to do so, order and apply biocontrol measures. Students are to continue monitoring pest populations after biocontrols are released. Record data.

Enrichment Activities:

1. Ask a greenhouse manager/owner that uses biological controls to come speak to the class or take a field trip to visit the greenhouse. Have students prepare appropriate questions ahead of time.
2. Contact the Pennsylvania Department of Agriculture with specific questions and/or for guidance to using biocontrols in the greenhouse.
3. Understanding Economic Injury Level (EIL) and Economic Threshold (ET) can be difficult for students. The PA IPM program has created an additional lesson teaching these concepts that may help students. The lesson is called Hopper Hunt and looks at the Potato Leafhopper in an alfalfa field. Students will “sample” the field for leafhoppers and make decisions about pest management based on several factors. Data needed to create the paper bag alfalfa fields is included. The lesson and data can be downloaded for free from: <http://extension.psu.edu/ipm/schools/educators/highschoolres/highschoolles/hopper-hunt> (accessed on 6/21/12)

Reading Connection:

An Ecological and Societal Approach to Biological Control edited by J. Eilenberg and Heikki M. T. Hokkanen

- Paperback: 336 pages
- Publisher: Springer Netherlands (Dec. 2009)
- ISBN-10: 9048171083
- ISBN-13: 978-9048171088

Natural Enemies Handbook: The Illustrated Guide to Biological Pest Control by Mary Louise Flint and Steve H. Driestadt

- Paperback: 154 pages
- Publisher: University of California Press (Feb. 1999)
- ISBN-10: 0520218019
- ISBN-13: 978-0520218017