

Module 3 ~ Why Manage Invasive Plants (MS/HS) Effects of *Lilioceris cheni* on Air Potato Growth



Adapted from a UF Brain Bowl Laboratory Exercise
Courtesy of Bill Overholt -- UF/IFAS Indian River Research & Education
Brought to you by the Invasive Plant Education Initiative / Center for Aquatic and Invasive Plants
<http://plants.ifas.ufl.edu/education>

Title: Effects of *Lilioceris cheni* on Air Potato Growth

Essential Questions: What is an invasive species? What is biological control, or “biocontrol”? Can the air potato leaf beetle (*Lilioceris cheni*) be used as an effective biocontrol for the invasive air potato vine in Florida?

Science Subject: biology, environmental science, life science

Grade Level: Middle School/High School (6-12)

Science Concepts: See list of suggested state standards at the end of this document

Overall Time Estimate: Two 50-minute class periods, two weeks apart; plants will need to be grown in advance by either teacher or students

Learning Styles: Visual and kinesthetic

Vocabulary: biological control, quarantine, bulbils, defoliation, nodes, invasive species, host-specific

Lesson Summary: Students work together to compare the growth of the invasive air potato vine when exposed to a biological control agent to the growth of an uninfested control plant. Students are introduced to the concept of biological control and to the ecological impacts of the invasive air potato vine in Florida.

Student Learning Objectives: Students will learn what a biological control agent is. They will also learn about Florida ecology and some of the impacts of invasive species.

Materials:

- ❖ Air potato plants – enough for each pair of students to have 2 plants (experiment and control). To grow air potato plants, collect bulbils from October to March. Plant in the spring.
 - Air potato is a noxious weed, and you need a permit to collect bulbils for educational use. See the “resources” section on our site for a link to the application form, as well as an example of a form filled out for this lab.
- ❖ Air potato leaf beetles – enough to put 4 on each experimental plant. To obtain the air potato leaf beetle contact Eric Rohrig with the Florida Department of Agriculture and Consumer Services via the beetle request form (details on page 4 of this teacher guide).



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- ❖ 2 liter soda bottles – one per air potato plant
- ❖ Mesh Screen – to place over holes in soda bottles to prevent beetles escaping
- ❖ Wooden dowels or sticks – one per air potato plant
- ❖ Student Data Sheets

Background Information:

Air potato vine is native to Asia and Africa and invasive in Florida. After its introduction to Florida in 1905, it spread rapidly around the state and has become a serious problem in a variety of habitats. The vine grows rapidly and is capable of climbing up and over trees, shrubs and other vegetation, displacing native plants and damaging habitat for a variety of species that depend on those plants.

A leaf feeding beetle was discovered in Nepal and China by scientists with the United States Department of Agriculture's Agricultural Research Service (USDA/ARS) and brought back to Florida for testing. Entomologists carefully studied the air potato leaf beetle (*Lilioceris cheni*) in a quarantined facility and found it to be an effective biological control for the air potato vine in Florida. Scientists have determined that the beetle is exclusively dependent on the air potato vine for its food and reproductive cycle (i.e., it is a "host-specific" insect). In 2011, the USDA's Animal and Plant Health Inspection Service (USDA/APHIS) approved the release of the beetle.

Advance Preparation:

- ❖ Fill out FDACS form to collect air potato for educational use.
- ❖ Collect air potato bulbils (October-March) and plant in individual pots. Warm conditions speed up sprouting.

Procedure and Discussion Questions:

- Teacher leads class in discussion to introduce the concepts of invasive species and biocontrol. Discussion questions can include the following:
 1. **What do plants need to survive?**
 2. **Where is air potato from?**
 3. **Why does it grow out of control?**
 4. **How do we know the air potato leaf beetle won't damage native plants?**



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Week 1

- 1) Teacher lead discussion on biocontrol
- 2) Pair students into teams. Each team receives 2 potted air potato plants, 2 2-liter bottles, scissors, mesh screen, and 2 Student Data Sheets.
- 3) Teams will count the number of leaves and nodes on each plant and measure the heights of the plants. Students will note measurements on the Student Data Sheet.
- 4) Students will cut off the bottom of each 2-liter bottle to create a cover for the potted plants. They will then make a few small air holes in two places on opposite sides of the 2-liter bottles, and attach mesh screen over the holes.
- 5) Students will then infest one plant with 4 recently hatched *Lilioceris cheni* larvae. The pots will be covered with the plastic 2-liter bottle to contain the beetles. Control plants without beetles will also be covered with a 2-liter bottle.

Week 3

- 1) The number of leaves and nodes on each plant will be counted and plant height will be measured and marked on the Student Data Sheet. The growth of infested and control plants between week 1 and week 3 will be calculated.
- 2) Assessment of overall plant conditions will be estimated using a scale of 0-5, with 0 = no damage and 5 = severe defoliation.
- 3) Students will describe the damage (parts of the plant consumed, consumption of new growth vs. old growth).
- 4) Data from all teams will be shared with the class and pooled to calculate mean growth of infested and control plants based on three parameters:
 - i. increase in number of leaves during two weeks
 - ii. increase in number of stem nodes during the two weeks
 - iii. increase in plant height during two weeks
 - iv. average damage score
- 5) Students illustrate data using graphs and then discuss the impact the beetles had on plant performance.



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Assessment Suggestions:

Students could produce a lab write-up in the form a short essay that can accompany their graph charts. The piece should adhere to Florida Standards for informational/explanatory writing and include discussion of the broader concepts of invasive species and biocontrols, as well as specifics about the air potato vine and the air potato leaf beetle.

Students could also write a creative story identifying air potato and/or other invasive species (such as kudzu, Brazilian pepper, pythons, and etc.) and imagining the possible effects of biocontrols. This piece could be built around Florida Standards for narrative writing, including elements such as detailed descriptions, dialogue and monologue, and character reflection. Students could also produce a short piece of persuasive writing that expresses their opinions and presents arguments about ways that humans should or should not change the behaviors that contribute to the spread of invasive species in Florida.

Extensions:

Students can take a field trip to observe air potato vines growing in natural Florida environments in their area, and collect bulbils for use in the lab. They may also organize the materials and plant the bulbils themselves to prepare for the lab.

Resources/References:

FL Department of Agriculture Air Potato Leaf Feeding Beetle Request Form:
<http://orange.ifas.ufl.edu/mq/pdf/AirPotatoBeetleRequest-Inst.pdf>

Website: *Air Potato Biological Control - Solutions for Your Life*
<http://bcrcl.ifas.ufl.edu/airpotatobiologicalcontrol.shtml>

Website: *Featured Creatures: Lilioceris cheni (air potato leaf beetle)*
http://entnemdept.ufl.edu/creatures/BENEFICIAL/BEETLES/air_potato_leaf_beetle.htm

EDIS Publication: *How Scientists Obtain Approval to Release Organisms for Classical Biological Control of Invasive Weeds*

- <http://edis.ifas.ufl.edu/IN607>
- <http://edis.ifas.ufl.edu/pdf/IN/IN60700.pdf>



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The following is a list of suggested standards that pertain to this activity. This list is provided as a reference to incorporate and expand upon as needed.

Next Generation Sunshine State Standards

6th Grade

SC.6.N.1.4: Discuss, compare, and negotiate methods used, results obtained, and explanations among groups of students conducting the same investigation.

7th Grade

SC.7.L.17.2: Compare and contrast the relationships among organisms such as mutualism, predation, parasitism, competition, and commensalism.

SC.7.L.17.3: Describe and investigate various limiting factors in the local ecosystem and their impact on native populations, including food, shelter, water, space, disease, parasitism, predation, and nesting sites.

SC.7.N.1.1: Define a problem from the seventh grade curriculum, use appropriate reference materials to support scientific understanding, plan and carry out scientific investigation of various types, such as systematic observations or experiments, identify variables, collect and organize data, interpret data in charts, tables, and graphics, analyze information, make predictions, and defend conclusions.

SC.7.N.1.4: Identify test variables (independent variables) and outcome variables (dependent variables) in an experiment.

8th Grade

SC.8.N.1.6: Understand that scientific investigations involve the collection of relevant empirical evidence, the use of logical reasoning, and the application of imagination in devising hypotheses, predictions, explanations and models to make sense of the collected evidence.

9th - 12th Grades

SC.912.L.17.5: Analyze how population size is determined by births, deaths, immigration, emigration, and limiting factors (biotic and abiotic) that determine carrying capacity.

SC.912.L.17.6: Compare and contrast the relationships among organisms, including predation, parasitism, competition, commensalism, and mutualism.

SC.912.N.1.1: Define a problem based on a specific body of knowledge, for example: biology, chemistry, physics, and earth/space science, and do the following: 1. pose questions about the natural world, 2. conduct systematic observations, 3. examine books and other sources of information to see what is already known, 4. review what is known in light of empirical evidence, 5. plan investigations, use tools to gather, analyze, and interpret data (this includes the use of measurement in metric and other systems, and also the generation and interpretation of graphical representations of data, including data tables and graphs), 7. pose answers, explanations, or descriptions of events, 8. generate explanations that explicate or describe natural phenomena (inferences), 9. use appropriate evidence and reasoning to justify these explanations to others, 10. communicate results of scientific investigations, and 11. evaluate the merits of the explanations produced by others.



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Common Core State Standards

6th Grade

| Common Core Code | FL Common Core Code | Common Core Standard |
|------------------|---------------------|---|
| RI.6.7 | LAFS.6.RI.3.7 | Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue. |
| W.6.2a | LAFS.6.W.1.2a | Introduce a topic; organize ideas, concepts, and information, using strategies such as definition, classification, comparison/contrast, and cause/effect; include formatting (e.g., headings), graphics (e.g., charts, tables), and multimedia when useful to aiding comprehension. |
| W.6.7 | LAFS.6.W.3.7 | Conduct short research projects to answer a question, drawing on several sources and refocusing the inquiry when appropriate. |
| SL.6.1 | LAFS.6.SL.1.1 | Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly. |
| SL.6.1c | LAFS.6.SL.1.1c | Pose and respond to specific questions with elaboration and detail by making comments that contribute to the topic, text, or issue under discussion. |
| L.6.3 | LAFS.6.L.2.3 | Use knowledge of language and its conventions when writing, speaking, reading, or listening. |
| RST.6-8.3 | LAFS.68.RST.1.3 | Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. |
| RST.6-8.6 | LAFS.68.RST.2.6 | Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text. |
| RST.6-8.7 | LAFS.68.RST.3.7 | Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). |
| RST.6-8.9 | LAFS.68.RST.3.9 | Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. |

7th Grade

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|-----------|-----------------|---|
| W.7.2a | LAFS.7.W.1.2a | Introduce a topic clearly, previewing what is to follow; organize ideas, concepts, and information, using strategies such as definition, classification, comparison/contrast, and cause/effect; include formatting (e.g., headings), graphics (e.g., charts, tables), and multimedia when useful to aiding comprehension. |
| W.7.7 | LAFS.7.W.3.7 | Conduct short research projects to answer a question, drawing on several sources and generating additional related, focused questions for further research and investigation. |
| SL.7.1 | LAFS.7.SL.1.1 | Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 7 topics, texts, and issues, building on others' ideas and expressing their own clearly. |
| SL.7.1c | LAFS.7.SL.1.1c | Pose questions that elicit elaboration and respond to others' questions and comments with relevant observations and ideas that bring the discussion back on topic as needed. |
| RST.6-8.3 | LAFS.68.RST.1.3 | Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. |
| RST.6-8.7 | LAFS.68.RST.3.7 | Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). |



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| RST.6-8.9 | LAFS.68.RST.3.9 | Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. |
| WHST.6-8.2a | LAFS.68.WHST.1.2a | Introduce a topic clearly, previewing what is to follow; organize ideas, concepts, and information into broader categories as appropriate to achieving purpose; include formatting (e.g., headings), graphics (e.g., charts, tables), and multimedia when useful to aiding comprehension. |
| WHST.6-8.9 | LAFS.68.WHST.3.9 | Draw evidence from informational texts to support analysis reflection, and research. |

8th Grade

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| W.8.2a | LAFS.8.W.1.2a | Introduce a topic clearly, previewing what is to follow; organize ideas, concepts, and information into broader categories; include formatting (e.g., headings), graphics (e.g., charts, tables), and multimedia when useful to aiding comprehension. |
| W.8.7 | LAFS.8.W.3.7 | Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. |
| SL.8.1 | LAFS.8.SL.1.1 | Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly. |
| SL.8.1c | LAFS.8.SL.1.1c | Pose questions that connect the ideas of several speakers and respond to others' questions and comments with relevant evidence, observations, and ideas. |
| RST.6-8.3 | LAFS.68.RST.1.3 | Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. |
| RST.6-8.7 | LAFS.68.RST.3.7 | Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). |
| RST.6-8.9 | LAFS.68.RST.3.9 | Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. |
| WHST.6-8.2a | LAFS.68.WHST.1.2a | Introduce a topic clearly, previewing what is to follow; organize ideas, concepts, and information into broader categories as appropriate to achieving purpose; include formatting (e.g., headings), graphics (e.g., charts, tables), and multimedia when useful to aiding comprehension. |

9th – 10th Grade

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| W.9-10.2a | LAFS.910.W.1.2a | Introduce a topic; organize complex ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. |
| W.9-10.7 | LAFS.910.W.3.7 | Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. |
| SL.9-10.1 | LAFS.910.SL.1.1 | Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively. |



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| SL.9-10.1c | LAFS.910.SL.1.1c | Propel conversations by posing and responding to questions that relate the current discussion to broader themes or larger ideas; actively incorporate others into the discussion; and clarify, verify, or challenge ideas and conclusions. |
| L.9-10.6 | LAFS.910.L.3.6 | Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression |
| RST.9-10.3 | LAFS.910.RST.1.3 | Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks attending to special cases or exceptions defined in the text. |
| RST.9-10.7 | LAFS.910.RST.3.7 | Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. |
| RST.9-10.9 | LAFS.910.RST.3.9 | Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts. |
| WHST.9-10.2a | LAFS.910.WHST.1.2a | Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. |

11th – 12th Grade

| | | |
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| W.11-12.7 | LAFS.1112.W.3.7 | Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. |
| SL.11-12.1 | LAFS.1112.SL.1.1 | Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 11–12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively. |
| SL.11-12.1a | LAFS.1112.SL.1.1a | Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas. |
| SL.11-12.1c | LAFS.1112.SL.1.1c | Propel conversations by posing and responding to questions that probe reasoning and evidence; ensure a hearing for a full range of positions on a topic or issue; clarify, verify, or challenge ideas and conclusions; and promote divergent and creative perspectives. |
| L.11-12.3 | LAFS.1112.L.2.3 | Apply knowledge of language to understand how language functions in different contexts, to make effective choices for meaning or style, and to comprehend more fully when reading or listening. |
| L.11-12.6 | LAFS.1112.L.3.6 | Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression. |
| RST.11-12.3 | LAFS.1112.RST.1.3 | Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text. |
| RST.11-12.7 | LAFS.1112.RST.3.7 | Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. |



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| RST.11-12.9 | LAFS.1112.RST.3.9 | Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. |
| WHST.11-12.2a | LAFS.1112.WHST.1.2a | Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. |



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