

## Module 3 ~ Why Manage Invasive Plants (MS/HS)

### Effects of *Agasicles hygrophila* on Alligator Weed Growth



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 *Agasicles hygrophila* on Alligator Weed Growth

**Essential Questions:** What is an invasive species? What is biological control, or “biocontrol”? Can the alligatorweed flea beetle (*Agasicles hygrophila*) be used as an effective biocontrol for the invasive alligator weed 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, defoliation, nodes, invasive species, host-specific

**Lesson Summary:** Students work together to compare the growth of the invasive alligator weed plant 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 invasive alligator weed 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

- ❖ Alligator weed plants – enough for each pair of students to have 2 plants (experiment and control).
  - Alligator weed is a noxious weed, and you need a permit to collect samples 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.
- ❖ Alligator weed flea beetles – enough to put 5 on each experimental plant. See links on page 4 of this Module under heading “Resources/References” for info on how to identify the plants and insects. See instructions on page 5 of this Module for details on how to trap the beetles.



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### Materials continued:

- ❖ 2 liter soda bottles – one per alligator weed plant
- ❖ Mesh Screen – to place over holes in soda bottles to prevent beetles escaping
- ❖ Student Data Sheets

**Background Information:** The greatest success in biological control of weeds in Florida was a program against alligator weed, *Alternanthera philoxeroides*. Alligator weed is an aquatic plant from South America that was first seen in the United States around 1890. In the 1960s, three species of insects from South America were introduced into Florida to control alligatorweed; a thrip (*Amynothrips andersoni*), a moth (*Vogtia malloi*) and a flea beetle (*Agasicles hygrophila*). The flea beetle was, and continues to be, the most successful agent.

### Advance Preparation:

- ❖ Fill out FDACS form to collect alligator weed for educational use.
- ❖ Collect alligator weed plants and plant in individual pots.
- ❖ Collect alligator weed flea beetles for use in lab.

### Procedure and Discussion Questions:

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



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### Week 1

- 1) Teacher lead discussion on biocontrol
- 2) Pair students into teams of 2. Each team receives 2 potted alligator weed plants.
- 3) Teams will count the number of leaves and nodes on each plant and measure the heights of the plants.
- 4) One of the plants will then be infested with 5 recently hatched *Agasicles hygrophila* larvae. The pots will be covered with a plastic 2 liter bottle to contain the beetles. Control plants without beetles will also be held in 2 liter bottles.

### Week 3

- 1) The number of leaves and nodes on each plant will be counted and plant height will be measured. 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 the three teams will be pooled to calculate mean growth of infested and control plants based on three parameter:
  - 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 of 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 alligator weed and the alligator weed flea beetle.

Students could also write a creative story identifying alligator weed and/or other invasive species (such as air potato vine, 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 alligator weed growing in natural Florida environments in their area, and collect plant and insect specimens for use in the lab. They may also organize the materials and plant the specimens themselves to prepare for the lab.

#### Resources/References:

*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>

*Alligator Weed*

- <http://plants.ifas.ufl.edu/node/33>

*Alligator Weed Flea Beetle*

- <http://edis.ifas.ufl.edu/in831>

*Biological Control of Weeds -- It's a Natural!*

- Located in the resource section of our website: <http://plants.ifas.ufl.edu/education>



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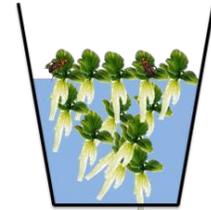
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**Collecting Alligator Weed Flea Beetles Using Bucket Insect Sampling Device:**

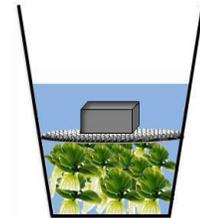
1. Half fill a white 5 gallon bucket with water and add plants to it



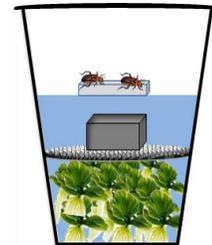
2. Cut a piece of round hardware cloth to fit inside the bucket



3. Place a weight (brick, rock, etc.) on top of the hardware cloth to immerse all plants under water

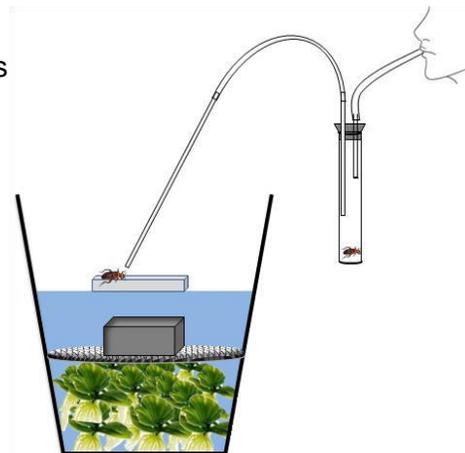


4. Float pieces of styrofoam block (approx 3-4") on the water – produces substrate for the bugs to crawl on, in addition to sides of bucket and underside of the lid



5. Cover the bucket with a lid, keep undisturbed for 10 mins

6. Use an aspirator to suck insects out



Adapted from material prepared by: Abhishek Mukherjee & James P. Cuda; Entomology and Nematology Department, UF



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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

##### 6<sup>th</sup> Grade

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

##### 7<sup>th</sup> Grade

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.

##### 8<sup>th</sup> 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.

MA.8.A.1.3: Use tables, graphs, and models to represent, analyze, and solve real-world problems related to systems of linear equations.

##### 9<sup>th</sup> - 12<sup>th</sup> Grades

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.

MA.912.A.2.1: Create a graph to represent a real-world situation.

MA.912.S.3.2: Collect, organize, and analyze data sets, determine the best format for data and present visual summaries.

MA.912.S.3.3: Calculate and interpret measures of the center of a set of data, including mean, median, and weighted mean, and use these measures to make comparisons among sets of data.



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**Common Core State Standards**

**Note:** Standards listed in *italics* are touched on briefly and can be fully developed by the teacher.

**6<sup>th</sup> 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.6.7	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.
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.6-8.4	LAFS.68.RST.2.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8 texts and topics.
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.

**7<sup>th</sup> Grade**

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.7.1a	LAFS.7.SL.1.1a	Come to discussions prepared, having read or researched material under study; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion.
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.
L.7.6	LAFS.7.L.3.6	Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases; gather vocabulary knowledge when considering a word or phrase important to comprehension or expression.
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.6-8.4	LAFS.68.RST.2.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8 texts and topics.
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.



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**8<sup>th</sup> Grade**

RI.8.4	LAFS.8.RI.2.4	Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze the impact of specific word choices on meaning and tone, including analogies or allusions to other texts.
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.8.1a	LAFS.8.SL.1.1a	Come to discussions prepared, having read or researched material under study; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion.
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.6-8.4	LAFS.68.RST.2.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8 texts and topics.
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.

**9<sup>th</sup> – 10<sup>th</sup> Grade**

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.
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.
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.
L.9-10.3	LAFS.910.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.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.



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11<sup>th</sup> – 12<sup>th</sup> Grade

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.11-12.6	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.
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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