**Biocontrol in action - unit plan**

**Overview**

Students carry out a practical investigation to monitor the spread of *Microctonus aethiopoides* (a tiny wasp) and its success as a biocontrol agent for clover root weevil.

**Purpose**

To investigate the efficacy of a real biocontrol agent in New Zealand and to understand the significance of biocontrol in the wider context of dairy farming.

**Background**

***Suggestions for a scenario***

The clover root weevil (CRW) arrived in New Zealand accidentally in the late 1990s. It destroys clover and, having no natural enemies, quickly became a major problem on dairy farms. As a result, an Irish wasp was introduced into New Zealand to help control the clover root weevil. Your job is to help scientists investigate how well this is working as a biocontrol strategy.

***Where's the biotechnology?***

*Microctonus aethiopoides*, a parasitoid wasp, is a natural enemy of the CRW and has been introduced in New Zealand as a means to control the CRW. In other words, a living organism (the wasp) is being used to control the population numbers of another living organism (the clover root weevil).

**Curriculum focus**

***Technological practice***

After gathering information and identifying the need, students will identify the nature and details of the issue and explore a feasible strategy to test an aspect of biocontrol.

***Technological knowledge***

Students will explore the technology of a specific example of biocontrol, identifying how the components are linked. Students will experience and report on a particular community of technological practice, i.e. a case study of the biocontrol of the CRW.

***Nature of technology***

Students will develop an awareness and understanding of how the development of an effective biocontrol system must take into account environmental pressures and societal attitudes in order for it to gain acceptance by the community.

***Science***

Living world: levels 3 and 4

* Explain how living things are suited to their particular habitat and how they respond to environmental changes, both natural and human-induced.
* Begin to group plants, animals, and other living things into science-based classifications.

Living world: levels 5 and 6

* Identify the key structural features and functions involved in the life processes of plants and animals and micro-organisms and investigate environmental factors that affect these processes
* Investigate the impact of natural events and human actions on a New Zealand ecosystem.

Living world: levels 7 and 8

* Explore ecological distribution patterns and explain possible causes for these patterns.
* Understand the relationship between organisms and their environment.

***Focus of skill and strategy***

Both science and technology can be integrated in this unit. Skills focus on developing a cage in which to rear a clover root weevil colony and check if it is infested with the parasitoid wasp.

**Health and safety**

* Wear gloves while sorting insects. Check that there are no harmful organisms (e.g. white tail spider) before handling.
* Wash hands before and after handling the colonies.

The following learning experiences will provide you with starting points for an exploration of this topic. You may decide to narrow your focus to one component or include most of the ideas in a unit that incorporates science and/or technology themes.

| **Suggested learning intentions** | **Suggested learning experiences** | **Possible teaching/assessment activities** |
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| **Introduction** | | |
| Learning to classify – identifying actual insects by looking at books and photos.  Recognising the role insects play in ecosystems and understanding that an unbalanced ecosystem may cause problems. | * Explore some books or websites on New Zealand insects. Which ones do you recognise? Which ones are new to you? Check out Landcare Research’s [What is this bug?](http://www.landcareresearch.co.nz/research/biosystematics/invertebrates/invertid/) * Brainstorm the sorts of insects you might find on a New Zealand farm. * Discuss how the insects and spiders might help/not help farm ecology, especially with a view to having productive land for farming (in particular, dairy farming).   **Classifying:**  Collect samples from clover paddocks and identify the different insects/spiders that are found. Provide magnifying lenses as well as photos/identification charts of common insects. Pay particular attention to any weevils. Sketch and label.  To collect samples, a modified blower vac machine could be used if available. Otherwise, dig a shallow square where clover is growing (check for notches missing in the leaves, indicating weevil activity). Collect clods of ground and clover in an ice cream container and leave overnight with a paper towel over the top – the weevils tend to come up to the paper. | In pairs, students explore insect books/websites. List some familiar and unfamiliar insects.  In groups, students identify insects in a sample. Sketch and label all the different insects. (Younger students could identify ‘their’ insects by ticking them off on a classification sheet.)  Students may draw simple food chains to help understand simple ecosystem relationships (grass, grass eating insects, spiders, birds). |
| **Introduce the scenario** | | |
| Understanding the scenario and identifying problems/learning needed. | Read out the scenario and brainstorm what students need to find out:   * What are clover root weevils? * What is the Irish wasp? * What is biocontrol? * What problem do we have to solve? * How could we find out about it? * What do we need to do first? | Class brainstorm. Record students’ ideas for research. |
| **Developing knowledge and skill** | | |
| Understanding the problem of the clover root weevil and how AgResearch are solving it.  Understanding biocontrol. | * Read the article [Irish wasp to the rescue](http://link.sciencelearn.org.nz/resources/1739-irish-wasp-to-the-rescue). * Learn to identify clover root weevils. Have pictures/photos of a number of common weevils. (The [AgPest website](http://agpest.co.nz/?pesttypes=clover-root-weevil) has images and written descriptions.)Discuss differences. Look at weevils collected from samples. Sketch and label them. You may find [Argentine stem weevil](http://agpest.co.nz/?pesttypes=sadasd), Doc weevil, [whitefringed weevil](http://agpest.co.nz/?pesttypes=whitefringed-weevil-adult), *Irenimus* species and the clover root weevil. * Each group takes out clover root weevils to set up a colony. * Examine the life cycles of the clover root weevil and the parasitoid wasp, *Microctonus aethiopoides*. Younger classes could use drama to act out the life cycles. * Arrange for the class to ask an expert about biocontrol. | Identification of clover root weevils.  Giving examples of biocontrol. |
| **Setting up a weevil colony** | | |
| In order to identify the suitability of wasps as biocontrol agents, you first need to set up and monitor colonies of the weevil pest. At the same time, you will be able to check for the presence of the wasp in your colony (the wasp lays its eggs inside the weevils). | Each group could make a colony with the weevils collected using the instructions below:   * Each group needs 2 rectangular plastic boxes (ice cream box size). * Cut the centre out of the lids of both boxes, leaving just the frames. * Cut the bottom out of one of the boxes and replace it with fine wire gauze glued in place. * Cut two rectangles of paper towel and one of plastic (from a plastic bag) to fit inside the box that still has its plastic bottom. * Place the paper towels on top of each other, with the plastic on top. (The plastic is to keep the paper towels dry.) * Place a lid frame on the box with the paper towels at the bottom. * Place the box with the wire gauze bottom on top of the other. It should sit just inside the lid frame. * Using an old camera film canister, pill bottle or other small container, make a 1.5cm cut about one-third down from the top, crosswise. * Make a little posy of clover with reasonably long stems. Fill the film canister with water and poke the clover stems clover through the slit. Replace the lid of the canister and place it in the top container, with the clover facing upright. * Add the clover root weevils (hopefully 20–50) to the top container. * Cut a piece of curtain mesh a little larger than the size of the box. Put it over the top and hold it in place with the lid frame. | Setting up and maintaining a clover root weevil colony. |
| **Maintaining the colony and checking for the Irish wasp** | | |
|  | * The clover will need to be changed every 3–4 days. * When changing the clover, hold the bottom box up to a light to check for the pupae of the parasitoid wasp. Remove any that you find. They will be attached to the paper, so cut a circle around them without touching them. * Place the circle (and pupa) in a petri dish with a lid. Leave in a warm place (about 20–25°C). The pupae should hatch in about 6–10 days. * Release the parasitoid wasp outside so it can join the others fighting the clover root weevils on our farms. * Keep a record of the number of parasitoid wasps you find. * Keep the clover root weevil colony for about 1 month. | Checking for the parasitoid wasp. |
| **Considering the ethics** | | |
| The community may have concerns regarding ecological implications of introducing a new species, like the Irish wasp. These must be explored before biocontrol can be used. | Discuss the consequences of using a parasitoid wasp as a biocontrol agent to:   * farmers – their clover and grass will grow, which gives better quality food for their cows, which produce better milk, so it’s money in the farmer’s pocket * scientists – jobs and income, sense of achievement and greater understanding, which can be used to help control of other pests * ecologists – possible concern about the effects on ecosystems: Will the parasitoid wasp affect other insects that are helpful? How can this be tested? For older students, what is the role of groups like Environmental Protection Authority (EPA)? * the clover root weevil – they die; what rights do they have, if any? * the parasitoid wasp – they wouldn’t be in New Zealand otherwise * other creatures * the general public.   In groups, use a plus minus interesting sheet to identify any benefits, harms and other interesting thoughts.  The weevil’s last stand (*Connected* No. 3: 2001) explores the ethics of pest control and biocontrol. | Class discussion. Note: [Managing classroom discussions](http://link.sciencelearn.org.nz/resources/198-managing-classroom-discussions) provides suggestions to facilitate and manage a safe, positive atmosphere.  Plus minus interesting (PMI) sheets.  Report on the existence of biocontrol of the clover root weevil in your area. |