

A Guide to Pest Scouting for the SER-UW Nursery

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(Photo cred. Kernock Park Plants)

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1. Introduction

Having pests munch and destroy nursery plants are inevitable, so it is imperative that constant monitoring takes place in order to control pest infestations. Integrated pest management is an approach to dealing with pests through cultural, physical, chemical, or biological management strategy or a combo of strategies. ¹ IPM exhausts all environmentally friendly methods of pest management before using pesticides as a last resort. This guide will give some insight on the scouting portion of IPM. Section 2 has tips on how to look for bugs, how to take notes will in the field, and how to rate the level of infestation. Section 3 will have background information on the behavior, signs of damage, and life cycle of the common pests that frequent the SER-UW Nursery. Section 4 is about common beneficial insects (and arachnids) and information on signs of their presence, their life cycle, and their favorite pests to consume. The last section discusses different aspects of scouting and research that can be further investigated in future projects. At the very end are appendices for nursery plants and sources.

2. How to Scout for Pests/Beneficials

Scouting Techniques

There is no single approach to scouting for bugs. And don't feel like you need to perfectly spot every single living thing on every plant. With time and practice, spotting pests and beneficials will become easier as you familiarize yourself with the common nursery pests and beneficials. Here are some steps to help get you started:

A. Briefly skim through the plants for any signs of damage (detailed in "Signs of Damage" subsection). If there are no obvious signs of damage... check this section later in the guide for guidance on how to look for insects.

B. Sample evenly throughout the plant species. Pull out a number of plants and examine them until you feel you have an overall picture of what this plant species might have (or not have). That could mean investigating 5

¹ Cloyd, Raymond A., Philip L. Nixon, and Nancy R. Pataky. *IPM for Gardeners: A Guide to Integrated Pest Management*. Portland: Timber Press, 2009.
p.8

plants out of 15 or 10 plants out of 20. There is no math equation, you will be developing a sense of how much sampling is enough the more you scout.

You should try to set a time out every week to come and scout for bugs. I spent 2-3 hours a week scouting on my own time, but any time you're at the nursery, whether it's the team work parties or volunteer work parties, you are constantly scouting. You begin to pick up on things for quickly the more time you spend doing this. And don't feel like you need to do this alone, the nursery managers and interns will also pick up on pests and beneficials that will assist you. Take notes on everything you and others find.

Signs of Damage

Here are some things you can look for as evidence for pests:

➤ Leaf Curl





Leaf curl happens when aphids suck the sap from the plants. Usually aphids can be found hiding underneath the curled leaves sucking away.

➤ Holes



It's a bit difficult to discern what is causing these holes in the leaves. But usually, you can suspect pests such as caterpillars, slugs, or snails. I'll occasionally find a few snails and caterpillars, but you won't encounter them every time you spot holes.

➤ Reddening



Reddening

happens when saliva of aphids, scales, or spider mites causes a reaction to the plant's leaves. If you look under the curled section of the leaf, you might be able to find the culprit. (Garden Insects of North America)

➤ Aphid skins



If you see this, this means there are aphids that have increased in size and left their skins behind (Source: Aphids in home gardens).

➤ Powdery Mildew



Powdery Mildew looks like someone spilled a bunch of flour onto the leaves of the plants, except you can't easily wipe it off.

➤ Rust

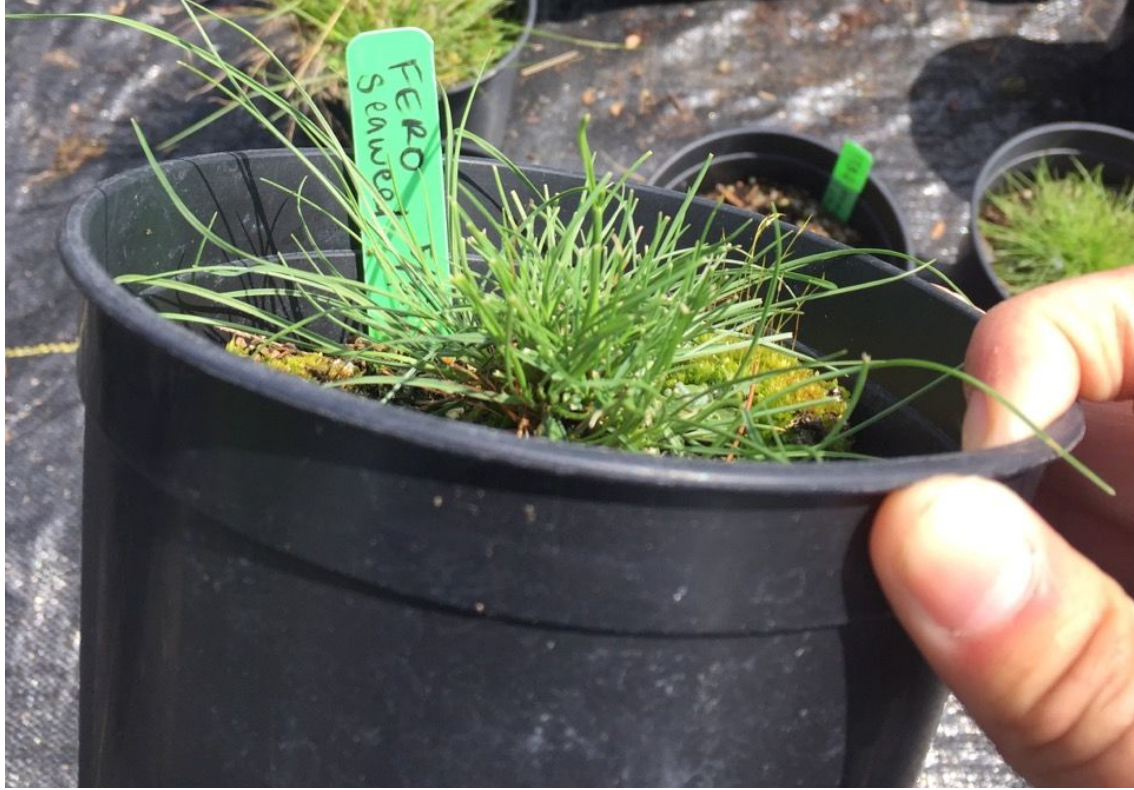


If you see orange spots in leaves, look closely. They're actually spores that land on the leaf and multiply.

➤ Bunny



(This is old damage, the cambium is no longer green)





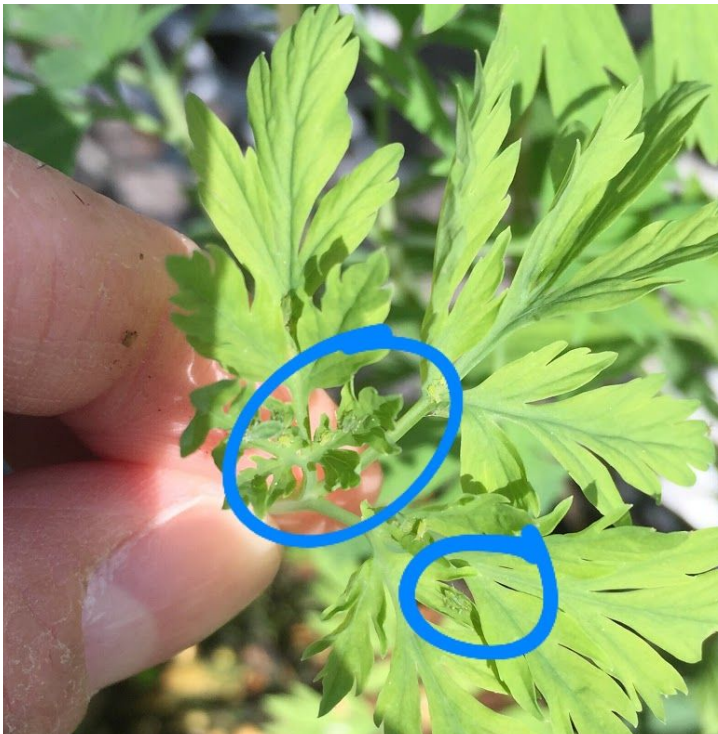
Bunnies munch on a lot of things. Look for grass blades that have the tip randomly missing (such as in the first photo) or branches that end abruptly (as in it looks like it's growth was stopped in its tracks). Anything that looks like it should continue but isn't was probably eaten by a bunny. For stems or branches, see if the cambium is still green. That means it's fresh. Be careful of old bunny bitings that may have been from a year ago. Those tend to look dry and browner than fresh munchings.

If No Obvious Signs of Damage

Still look closely because even if there are no obvious signs of damage, there may be some pests lurking around like these aphids here:



See how there isn't obvious leaf damage? And these aphids:



They blend in so well! If you don't immediately spot guys like this, don't feel bad. It'll take time to get used to being able to spot these guys immediately when looking at plants, but don't be afraid to stick your nose up close to it.

How to Take Notes

Set up a chart like this in your field notes:

Date	Plant Species #1	Plant Species #2	Etc.
MM/DD/YY Ex. 05/14/18	-Location (Hoop house or Outside) -Pot size (½ gal., 2 gal. etc.) -Observations of Pests/Beneficials -location pest/beneficial was found on plant -Severity (Rating Scale explained in the “Severity Scale” subsection”)	Ex. Dicentra Formosa (This would go in the box above) -Hoophouse -1 gal. -Aphids -underneath leaves on new growth stems -5	
		-Outside -2 gal. -Parasitic Wasps -on top of leaves were Aphid mummies -3	
05/17/18		-blah blah blah more notes from a different day	

There are a lot of plant species at the nursery, so this may take up a lot of room in your notebook. Refer to Appendix A for a full list of the nursery plant species. Also, notice in the example that there are two boxes filled out for *Dicentra Formosa* on the same day. Sometimes there will be the same species both inside and outside the hoop house or the plants may be different ages so require different sized pots. Keep as detailed of notes as possible.

The Rating System: Severity

The Severity Scale is meant to help discern whether a plant species needs immediate treatment of the pest or if the infestation is light enough that beneficials can be trusted to handle the task. We use a scale from 1 to 5, 1 being “minimal infestation” and 5 being “Severe infestation”. The method of determining the severity of an infestation is dependent on the type of bug. Different insects (and arachnids) have different behavioral patterns such as reproductive rates or tendency to stay in concentrated packs.

- Example #1: aphids
 - Reproduce very rapidly and stay in concentrated packs
 - Will even have a winged form for when a plant is too overcrowded

If I see something like this for aphids:



Where there are a large amount of aphids under the curled leaves of this plant. And there was visible damage on a number of leaves and had multiple plants infected, this would be rated a 5. But if it looks something like this:



And 80% - 100% of the plants within the species have infestations that look like this would be a 4. 50% - 70% of the plants with an infestation like this would be rated a 3, and so on.

The main idea is **pay attention to how many plants are infected and how badly each plant is infected.**

- Example #2: Spiders
 - Spiders don't reproduce as quickly as aphids
 - They are more spread apart between plants



If I see one spider, I rate it as 1. If I see three spiders, I'll rate it as 3. And if I see 5 or more, I rate it as 5. Basically for the highly reproductive bug species, I will rate according to the density of their presence on the plant species. And for low reproductive bug species, I will rate based on the literal amount of bugs I see and count.

In the end, the way you rate infestations will be based on your own judgement. When looking at a plant species and determining how to rate the severity, it's helpful to think "does this need immediate treatment?", if yes, that usually means it's a 4 or 5. If you rate between 1-3, you can depend on the beneficial insects to eliminate those pests populations.

3. Common Nursery Pests

Insects

➤ Aphids

Aphids are soft-bodied insects that suck sap from stems, leaves, or roots. They reproduce very rapidly and create large populations that infest plants and damage them. Some symptoms include:

- clusters of aphids in concentrated areas of the plant

- stunted growth and deformation of leaves and stem (refer to Signs of Damage in How to Scout section for photo)
- Sticky honeydew found on stems and leaves produced by aphids





Life cycle²

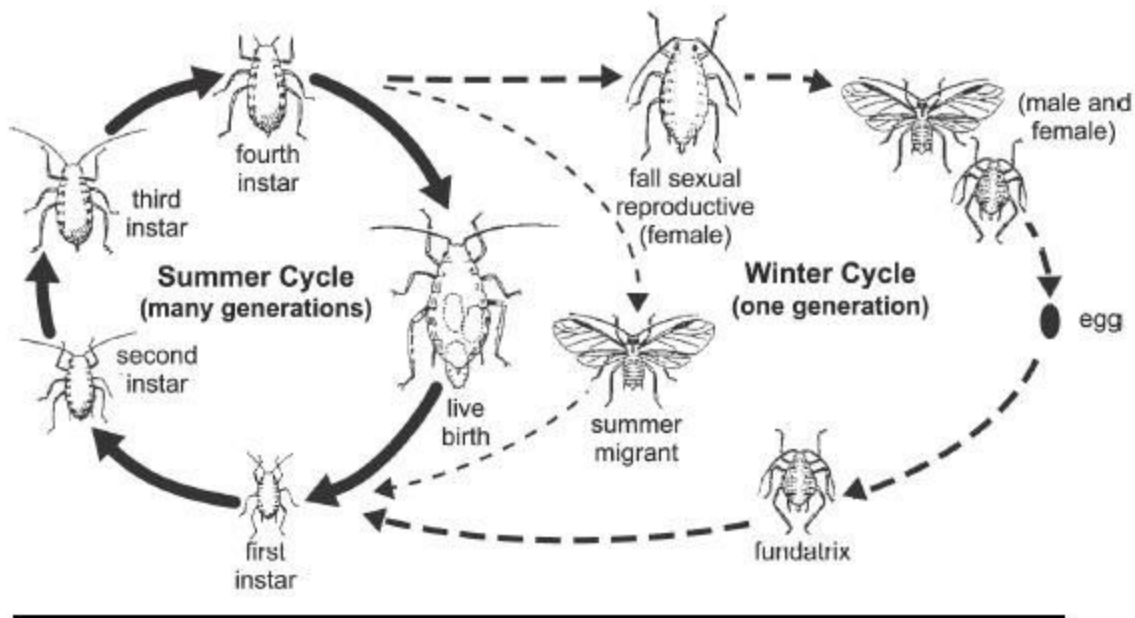


Figure 2. General life cycle of aphids. Asexual reproduction occurs during most of the year (summer cycle). Some aphid species produce a generation of sexual individuals that produce overwintering eggs as shown in the winter cycle.

The lifecycle of an aphid begins with overwintering in the egg stage which then hatches in the spring. From then on, the eggs hatch in the Spring and continue to reproduce asexually during the growing season. At the end of the

² "Aphids." Ludwigs Roses. September 17, 2016. Accessed June 09, 2018. <http://www.ludwigsroses.co.za/rose-care/aphids-2/>.

growing season, males and females will mate and produce eggs for the next year. During the growing season, winged form adults can develop if a plant is too overcrowded and there becomes a necessity for the winged adult to move to a nearby plant and recolonize.

Treatment

➤ Cultural

- Squashing the aphids with your fingers if there are only a few on a stem or two
 - Or if they're on leaves, just close the leaves and squash them inside (giant, evil human)
- Prune off curled leaves that act as cover for the aphids, and then use a high powered jet stream of water to blast them off of the stems and leaves

➤ Biological

- Ladybugs (especially ladybug larvae)
- Parasitic Wasps

➤ Chemical

- Insecticidal soap

➤ **Roseslugs³**

Roseslugs are the larvae of sawflies that feed on the leaves of rose shrubs. Some symptoms include:

- Leaves that look papery with a translucent surface and veins

³ "Rose and Pear Slugs (sawflies)." Missouri Botanical Garden. Accessed June 09, 2018. <http://www.missouribotanicalgarden.org/gardens-gardening/your-garden/help-for-the-home-gardener/advice-tips-resources/pests-and-problems/insects/sawflies/rose-and-pear-slugs-sawflies.aspx>.





Life cycle

Adult sawflies emerge in early Spring and lay their eggs on the undersides of plant leaves. Several weeks later, the larvae will feed on soft leaf tissue for a month before dropping into the ground to pupate.

Treatment

➤ Cultural

- For light infestations, remove infested leaves and destroy the larvae.
- Knock off larvae by spraying a strong jet stream of water on the leaves
 - Make sure to get top and undersides of leaves

➤ Biological

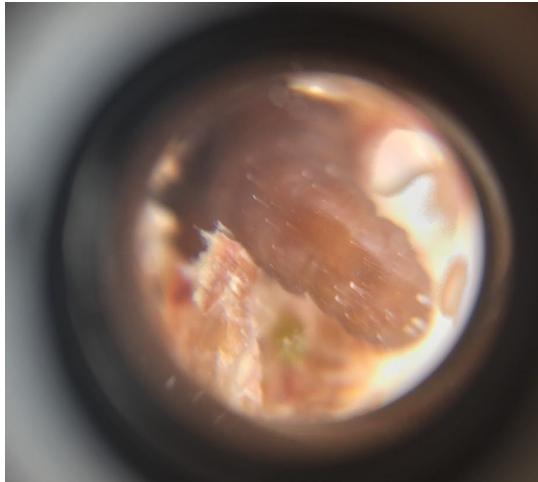
- Parasitic Wasps
- Insectivorous birds
- Predaceous beetles

➤ Chemical

- Insecticidal soap
 - Use early at a young age

➤ **Pine Borers**

Pine borers are larvae hatched from eggs of beetles that feed on trees by boring holes into the wood. There are many different types of beetles and different looking larvae, in this instance, the pine borer found was brown and about an inch long. It was found in the *Pinus contorta* (Lodgepole pine).



Symptoms include:

- Tree tips easily break off when touched
- Holes in stems going in vertically, larvae continue to borrow deeper into the stem

Life cycle

*Currently unavailable. I am having trouble identifying what beetle left this larvae, and so I can't find information on it's life cycle.

Treatment

➤ Cultural

- Prune the branches that have signs of burrowing happening
 - How much to prune depends on how deeply the larvae has burrowed. Prune until you no longer see a hole in the branch

➤ **Thrips⁴**

Thrips are elongated tiny insects that suck plant cells and can also transmit diseases to plants. They can be either yellow, brown, or black with slender, tiny bodies and narrow, fringed wings. Nymphs are even smaller, but tend to

⁴ Old Farmer's Almanac. "Thrips." Old Farmer's Almanac. Accessed June 09, 2018. <https://www.almanac.com/pest/thrips>.

light green or yellow. It is beneficial to use a magnifying glass when trying to spot thrips.





Thrip nymph

Some symptoms include:

- Streaks, silvery speckling, and small white patches of leaves





- Stunted plants with damaged flowers and fruit

Life cycle

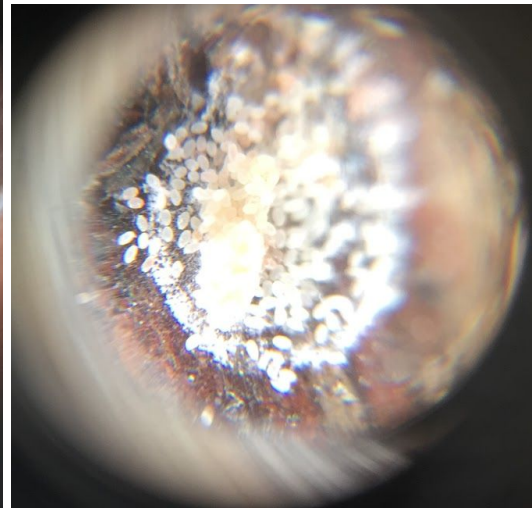
Adult thrips overwinter in plant debris, bark, or other materials. They become active in the spring and begin to lay eggs in plant tissue. Those eggs hatch in 3 - 5 days. The nymphs feed for 1 - 3 weeks and then rest to molt in 1 - 2 weeks. There are generally 15 generations of thrips in a year. Adults live for about 1 month.

Treatment

- Cultural
 - Yellow or blue sticky traps
 - Shaking branches and catching them in a cloth
 - Dust undersides of leaves with diatomaceous earth as a last resort
- Biological
 - Lacewings
 - Lady bugs

➤ **Scales**

Scales are sucking insects that insert their mouthparts into the stems of plants and secrete a hard protective covering over themselves. If the scale is removed, the insect body still remains.



Symptoms include:⁵

- When abundant, scales weaken a plant and cause it to grow slowly (IPM).
- Plants appear water stressed, leaves turn yellow and may drop prematurely

Life cycle⁶

⁵ "How to Manage Pests." UC IPM Online. Accessed June 09, 2018.
<http://ipm.ucanr.edu/PMG/PESTNOTES/pn7408.html>.

⁶ "How to Control Scale Insects." Planet Natural. Accessed June 09, 2018.
<https://www.planetnatural.com/pest-problem-solver/houseplant-pests/scale-control/>.

Adult females lay eggs underneath their protective armor covering. Those eggs hatch any time between 1 - 2 weeks. Those newly hatched nymphs crawl around searching for a place to settle to then continue by inserting their mouthparts and begin feeding. Those nymphs then develop their own armor and become immobile adults.

Treatment⁷

- Cultural
 - Prune infested branches, twigs, and leaves
 - Rub or pick off by hand (if populations are low)
- Chemical
 - Dab individuals with alcohol-soaked cotton swabs(if populations are low)
 - Horticultural oils will smother insects
- Biological
 - Lady bug
 - Lacewing

➤ **Fungus Gnats**

Fungus gnats are grayish black mosquito-like flies with long legs and one pair of clear wings. The gnats themselves are not harmful in the adult phase, it is the larvae that is of concern. The larvae have a shiny black head with an elongated, whitish to transparent body. They are most abundant on damp, rich soils and feed on root hairs of plants.⁸

Symptoms include:

- Bright yellow leaves
- Slow growth
- Presence of small flies

⁷ "How to Control Scale Insects." Planet Natural. Accessed June 09, 2018.
<https://www.planetnatural.com/pest-problem-solver/houseplant-pests/scale-control/>.

⁸ "Fungus Gnat Larvae in Soil." Orkin.com. Accessed June 09, 2018.
<https://www.orkin.com/flies/gnats/fungus-gnat-larvae/>.



Life cycle

Adult fungus gnats live for one week and within that time, they can lay up to 300 eggs in rich, moist soils. Those tiny larvae emerge within 4 - 6 days and begin feeding on plant roots in a two week period. The pupal stage lasts 3 - 4 days before the young adults leave the soil to begin the next generation.

Treatment⁹

- Preventative
 - Avoid overwatering
 - If pests are present, allow soil to dry 1 to 2 inches in depth
- Cultural
 - Place yellow sticky traps horizontally on the soil to capture egg laying adults
- Biological
 - Beneficial nematodes (this will require a commercial purchase)

Diseases

➤ **Powdery Mildew**

Powdery Mildew is a fungal disease that has an appearance that looks as if the leaves were dusted with flour. Powdery Mildew is made up of many spores that are carried by the wind and find a place on plants.

Symptoms include:¹⁰

- Small, circular, white spots which then eventually develop to fully cover leaves with the white powder.

⁹ "How to Get Rid of Fungus Gnats." Planet Natural. Accessed June 09, 2018.
<https://www.planetnatural.com/pest-problem-solver/houseplant-pests/fungus-gnat-control/>.

¹⁰ Old Farmer's Almanac. "Powdery Mildew." Old Farmer's Almanac. Accessed June 09, 2018.
<https://www.almanac.com/pest/powdery-mildew>.



Treatment¹¹

➤ Cultural

- Rub infected leaves together to partially remove the disease
- Prune any leaves and stems that have the disease
 - Do not dispose cuttings in small compost next to hoop house because it may spread the disease to the rest of the compost and risk infection of other plants.
 - Instead, dispose of pieces in large compost right outside Douglas Research Conservatory. The heat is high enough in that to kill the mildew spores.
- Baking soda: mix 1 tablespoon of baking soda to 2.5 tablespoons of horticultural oil and spray.
- Make sure to prune plants to increase air circulation to reduce humidity.

➤ Rust

Rust is a fungal parasite that is spread by spores through wind, water, or between leaves of a plant.

Symptoms include:

¹¹ Market, Growing For. "Home Remedies for Powdery Mildew - Growing for Market." Spice up Your Summer Greenhouse with Ginger - Growing for Market. January 01, 2008. Accessed June 09, 2018. <https://www.growingformarket.com/articles/powdery-mildew-solutions>.

- Bright orange spots on leaves





Treatment

➤ Cultural

- Prune infected leaves
- Avoid wetting leaves when watering
- Space plants properly to increase air circulation

Adorable Little Sh*ts

➤ **Bunnies**

Bunnies are out there to survive by eating without being eaten. The nursery is a predator-less buffet for these creatures. Although these bunnies are very cute, they can cause a lot of damage to plants. It's pretty easy to identify them since they're generally fluffy and round, but picking out the damage is a bit more difficult.



Photo Credit: Will Braks

Symptoms include: (Reference photos in "Signs of Damage" section)

- (for graminoids) any blades that don't have the pointy tip, but instead looks like it's cut off
- Bite marks on stems of woody species (fresh ones should still have it's green cambium visible)
- Branches that look like they were abruptly cut off

Treatment¹²

➤ Cultural

- Place around the nursery little drawstring bags full of Irish Spring shavings
- Place jars of water around (bunnies are afraid of their own reflection)
- Sprinkle powdered red pepper around the nursery
- Sprinkle dried sulfur around the nursery

➤ **Snails and slugs**¹³

Snails and slugs are hermaphrodite and so are all capable of laying eggs. They are most active at night or on cloudy/foggy days and hide during the daytime. I have found a few resting at the proximal end of plants on top of the soil in pots.



(From left to right) Photo credit: Brandy Do, Jack Kelly Clark

Symptoms include:

¹² Old Farmer's Almanac. "Rabbits." Old Farmer's Almanac. Accessed June 09, 2018. <https://www.almanac.com/pest/rabbits>.

¹³ "How to Manage Pests." UC IPM Online. Accessed June 09, 2018. <http://ipm.ucanr.edu/PMG/PESTNOTES/pn7427.html>.

- Irregular holes on smooth edges of leaves

Lifecycle¹⁴

Snails/slugs lay eggs once a month and can lay between 100 - 400 of them. They get laid in the moist soil. But many end up getting washed away or eaten by predators. The remaining eggs hatch after approximately 2 weeks to 1 month. When mature, they can live between 2 to 7 years (that's so long).

Treatment

- Cultural
 - Hand picking - draw them out by watering the infested area in the late afternoon¹⁵

4. Common SER Beneficials

➤ **Ladybug¹⁶**

Ladybugs are cute little insects that are large predators to aphids, scales, mealybugs, leafhoppers, mites, and other soft bodied insects. Ladybugs can consume 50 to 60 aphids a day reaching 5,000 in their lifetime. Ladybug larvae are actually more useful in IPM because there is a higher concentration of them when they hatch and they eat their weight's worth in aphids a day and continue to feed once they're an adult.



¹⁴ "Snail Life Cycle." Snail Facts and Information. Accessed June 09, 2018. <https://www.snail-world.com/life-cycle-of-a-snail/>.

¹⁵ "How to Manage Pests." UC IPM Online. Accessed June 09, 2018. <http://ipm.ucanr.edu/PMG/PESTNOTES/pn7427.html>.

¹⁶ "Garden Ladybugs." Beetles: Beneficial Insects - Natural Organic Biological Pest Control. Accessed June 09, 2018. <https://www.buglogical.com/garden-ladybugs/>.

Life cycle

In the spring, females lay between 50-300 eggs. The eggs are tiny football shaped and are found in clusters of 10-50 near aphid colonies. These eggs take 3-5 days to hatch and once they do, the larvae will feast on aphids for another 2-3 weeks before pupating into adults. Ladybugs hibernate in plant refuse crevices during the fall and hide in logs, buildings, ground covering vegetation and other safe places during the winter. Once winter transitions to spring, the ladybugs will fly to fields where the cycle begins over again.

○ Lady bug Larvae



Ladybug eggs - PC: Inspired Room



➤ **Syrphid flies¹⁷**

Syrphid flies (also known as hoverflies) are true flies that look like small bees or wasps. They fly by darting a short distance and then hovering, as if in a

¹⁷Carroll, Jackie. "The Beneficial Hover Fly ? How To Use Hover Flies In Gardens." Gardening Know How. April 05, 2018. Accessed June 09, 2018. <https://www.gardeningknowhow.com/garden-how-to/beneficial/hover-flies-in-gardens.htm>.

zigzag motion. The syrphid fly itself isn't the one that consumes pests, it's their larvae that do.



PC: Susan Ellis



PC: AnimalSake

Life cycle

Females lay their creamy white eggs near aphids colonies and those eggs hatch in 2-3 days. Once hatched, the larvae feed on aphids for several days until they attach themselves to a stem to build a cocoon. During warm weather, they'll spend 10 days or so inside the cocoon, but during cool weather they will spend longer. Then, adults will emerge to start the cycle all over again.

- Syrphid Larvae



➤ Spiders

There are many different types of spiders that frequent the nursery and they are usually generalists who will consume a majority of insects.



Life cycle¹⁸

Female spiders store sperm from mating until they are ready to produce eggs. They fertilize the eggs as it is deposited into a constructed sac made of

¹⁸ Hadley, Debbie. "Do You Know How Long a Spider Lives?" ThoughtCo. Accessed June 09, 2018. <https://www.thoughtco.com/the-spider-life-cycle-1968557>.

strong silk. Eggs take a few weeks to hatch and once they do, the spiderlings disperse immediately. Spiderlings molt repeatedly as they grow larger and usually reach adulthood after 5 to 10 molts. Spiders usually live for 1 to 2 years after reaching adulthood, but it is dependent on the species.

➤ **Parasitic Wasps¹⁹**

Parasitic Wasps prey on pests by inserting their eggs into them. They are very useful for reducing pest populations such as aphids, roseslugs, and scale.



PC: UGA CAES

- Aphid mummy
 - This is a sign of parasitic wasp presence. Aphid mummies are a result of having parasitic wasp eggs injected into their bodies.



¹⁹ Cedarcirclefarm. "Beneficial Insect: Parasitic Wasp." Cedar Circle Farm – Organic Farmstand and Education Center. Accessed June 09, 2018. <https://cedarcirclefarm.org/tips/entry/beneficial-insect-parasitic-wasp>.



PC: University of

Nebraska

Life cycle

Females lay eggs inside or on host insects. The wasp eggs then hatch and consume prey. After feeding, some species then pupate in external cocoons (attached to the host's body) while other pupate within the prey and emerge as adults. They have a high reproductive capacity and develop rapidly.

5. Advancing this Project for Future Quarters

Throughout this quarter, I was able to develop my skills in scouting for insects and developed an overall understanding of what pests and beneficials frequent the nursery. But since a quarter is two short of a time period, here are some things that I wish I had more time to expand on. One section will talk about different aspects of scouting I would have liked to expand on. The second section is about topics that I would have researched if I had more time. This section's purpose is to illustrate portions of the project that can be expanded on by future quarters. Feel free to use these topics to guide your research, but you are also welcome to bring new ideas to this project if you believe that will improve the SER-UW Nursery's integrated pest management program!

Scouting

- Currently the beneficial insectary is being built. Once it is done, observe if there is a higher quantity of beneficial insects compared to the current volume.
- Utilize Garden Insects of North America by Whitney Cranshaw and David Shetlar - this book really aided me in identifying new symptoms of pests and just new pests in general.
- By the end of the internship, there were still pests that I didn't have a grip on how to find them and what damage they did. It was mostly due to not being familiar to all of the pests. Advice: get familiar with all the pests/beneficials and signs on how to find them. Then just spend tons of time in the nursery looking at plants.

Here's the list:

- Thrips
- Pine Borers
- Scales
- Fungus gnats

This by no means is the complete list of pests that still needs to be recorded in the records, so it is up to future interns to expand the knowledge for the nursery.

- Utilize Yellow Sticky Traps in the beginning of the quarter
 - This is a resource that I forgot existed
 - It will be very helpful for catching any flying pests

Research

- Research whether specific nursery plants attract certain pests more than others
 - To see if certain species are more susceptible to some pests than others or to know what pests to look out for
- More research on the difference between the different colored aphids
 - Are the red ones more likely to like a certain plant than the green ones?
 - Are any types of aphids more difficult to treat than others?
- Research methods to prevent bunnies from coming
 - I briefly read in a book that if you stick glass bottles halfway into the ground, the sound of the wind on the glass will scare the bunnies
 - Research other methods
- Systemics pesticides

- Pesticides absorbed by plants and moved throughout it's tissues to act against pests
- More research on this method and whether it would be beneficial for the nursery
- Life stages of pests
 - where and when to look for eggs
- Analyze current scouting data and any new observations to see which plants get pests the most, which pests are the most common for each plant, etc.

Appendix A - Plant Species

<u>Latin Name</u>	<u>Common Name</u>	<u>4-Letter Code</u>
Abies grandis	Grand Fir	ABGR
Abies procera	Noble Fir	ABPR
Acer circinatum	Vine maple	ACCI
Acer macrophyllum	Big Leaf Maple	ACMA
Achillea millefolium	Yarrow	ACMI
Achlys triphylla	Vanilla Leaf	ACTR
Allium cernuum	Nodding Onion	ALCE
Alnus rubra	Red Alder	ALRU
Amelanchier alnifolia	Pacific Serviceberry	AMAL
Anaphalis margaritacea	Pearly Everlasting	ANMA
Aruncus dioicus	Goat's Beard	ARDI
Arbutus menziesii	Pacific Madrone	ARME
Athyrium filix-femina	Lady Fern	ATFI
Blechnum spicant	Deer Fern	BLSP
Carex obnupta	Slough Sedge	CAOB
Carex inops	Long-Stolon Sedge	CAIN

<i>Carex lenticularis</i>	Lakeshore Sedge	CARLEN (or CALE)
<i>Camas leichtlinii</i>	Great Camas	CALE5
<i>Camas quamash</i>	Small Camas	CAQU
<i>Carex tumulicola</i>	Foothill Sedge	CATU
<i>Cerastium arvense</i>	Field chickweed	CEAR
<i>Cornus sericea</i>	Redosier dogwood	COSE
<i>Crataegus douglasii</i>	Black Hawthorn	CRDO
<i>Danthonia californica</i>	California Oatgrass	DACA
<i>Deschampsia cespitosa</i>	Tufted Hairgrass	DECE
<i>Dichelostemma congestum</i>	Ookow	DICO
<i>Dicentra formosa</i>	Pacific Bleeding Heart	DIFO
<i>Dryopteris expansa</i>	Wood Fern	DREX
<i>Erigeron speciosus</i>	Aspen Fleabane	ERSP
<i>Eriophyllum lanatum</i>	Wooly Sunflower	ERLA
<i>Festuca roemerii</i>	Roemer's Fescue	FERO
<i>Fraxinus latifolia</i>	Oregon ash	FRLA
<i>Gaultheria shallon</i>	Salal	GASH
<i>Geum macrophyllum</i>	Large-leaved avens	GEMA
<i>Glyceria striata</i>	Foul Managrass	GLST
<i>Glyceria elata</i>	Tall Managrass	GLEN
<i>Grindelia integrifolia</i>	Puget Sound Gumweed	GRIN
<i>Heuchera micrantha</i>	Alumroot	HEMI
<i>Holodiscus discolor</i>	Oceanspray	HODI
<i>Hydrophyllum tenuipes</i>	Pacific Waterleaf	HYTE
<i>Juncus acuminatus</i>	Tapered Rush	JUAC

<i>Juncus tenuis</i>	Slender Rush	JUTE
<i>Koeleria macrantha</i>	Junegrass	KOMA
<i>Lilium columbianum</i>	Columbian Lilly	LICO
<i>Lonicera involucrata</i>	Twinberry	LOIN
<i>Lupinus latifolius</i>	Broadleaf Lupine	LULA
<i>Lupinus lepidus</i>	Pacific Lupine	LULE
<i>Lupinus polyphyllus</i>	Bigleaf Lupine	LUPO
<i>Maianthemum dilatatum</i>	False Lilly of the Valley	MADI
<i>Malus fusca</i>	Pacific crabapple	MAFU
<i>Mahonia aquifolium</i>	Tall Oregon Grape	MAAQ
<i>Mahonia nervosa</i>	Low Oregon Grape	MANE
<i>Myrica gale</i>	Sweetgale	MYGA
<i>Oemleria cerasiformis</i>	Indian plum	OECE
<i>Oenanthe sarmentosa</i>	Pacific Water-Parsley	OESA
<i>Ozmorhiza chilensis</i>	Sweet Cicely	OZCH
<i>Physocarpus capitatus</i>	Ninebark	PHCA
<i>Philadelphus lewisii</i>	Lewis' Mock Orange	PHLE
<i>Pinus contorta</i>	Shore Pine	PICO
<i>Picea sitchensis</i>	Sitka Spruce	PISI
<i>Polypodium glycyrrhiza</i>	Licorice Fern	POGL
<i>Potentilla gracilis</i>	Slender Cinquefoil	POGR
<i>Polystichum munitum</i>	Sword Fern	POMU
<i>Populus trichocarpa</i>	Black Cottonwood	POTR
<i>Pseudotsuga menziesii</i>	Douglas Fir	PSME
<i>Quercus garryana</i>	Garry Oak	QUGA
<i>Ranunculus occidentalis</i>	Western Buttercup	RAOC
<i>Rhamnus purshiana</i>	Cascara	RHPU

<i>Ribes divaricatum</i>	Coastal Black Gooseberry	RIDI
<i>Ribes sanguineum</i>	Red Flowering Currant	RISA
<i>Rosa gymnocarpa</i>	Baldhip Rose	ROGY
<i>Rosa nutkana</i>	Nootka Rose	RONU
<i>Rosa pisocarpa</i>	Bunch Rose	ROPI
<i>Rubus leucodermis</i>	White Bark Raspberry	RULE
<i>Rubus parviflorus</i>	Thimbleberry	RUPA
<i>Rubus spectabilis</i>	Salmonberry	RUSP
<i>Rubus ursinus</i>	Trailing Blackberry	RUUR
<i>Salix lucida</i>	Shinning Willow	SALU
<i>Sambucus racemosa</i>	Red Elderberry	SARA
<i>Schoenoplectus acutus</i>	Common Tule	SCAC
<i>Scirpus microcarpus</i>	Small-flowered Bullrush	SCMI
<i>Sedum spathulifolium</i>	Broadleaf Stonecrop	SESP
<i>Solidago canadensis</i>	Canadian Goldenrod	SOCA
<i>Spiraea douglassi</i>	Hardhack	SPDO
<i>Stachys cooleyae</i>	Cooley's Hedge-Nettle	STCO
<i>Symphoricarpos albus</i>	Snowberry	SYAL
<i>Tellima grandiflora</i>	Fringecup	TEGR
<i>Thuja plicata</i>	Western red cedar	THPL
<i>Tolmeia menziesii</i>	Piggy-back Plant	TOME
<i>Tsuga heterophylla</i>	Western Hemlock	TSHE
<i>Vaccinium ovatum</i>	Evergreen Huckleberry	VAOV
<i>Vaccinium parvifolium</i>	Red Huckleberry	VAPA
<i>Viburnum edule</i>	High Bush Cranberry	VIED

Appendix B - Sources

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