

Spring 2027: Project Orchid Experiment

Orchids Grow in Many Ways

- **Epiphytic:** on other plants
- **Lithophytic:** on rocks
- **Terrestrial:** in the ground
- About **73%** of orchids are epiphytic or lithophytic.

Seeds

- Orchid seeds are extremely small, the smallest of any plant family.
- One seed capsule can hold thousands of seeds.

Why so many tiny seeds? Small size and large numbers raise the odds that a seed will land near a fungal partner.

How do they survive? Plants with larger seeds store food for germination. Orchid seeds carry

almost none, so they rely on fungi to supply what they need to germinate and get established.

Orchids and Fungi (Mycorrhizae)

The orchid-fungus partnership is called **mycorrhizae**. Orchids appear to need it as seeds *and* as mature plants, and the fungal species involved can change as the plant ages.

- Fungi form **pelotons** (coils) inside root cells.
- Most orchids keep getting nutrients from fungi as adults.
- Fungi help orchids tolerate stress.

When a fungus tries to infect an orchid seed, there are three possible outcomes:

1. The fungus fails to infect the seed.
2. The fungus infects and overwhelms or parasitizes the embryo.
3. The fungus infects, but the orchid "turns the tables" and takes nutrients from the fungus. The fungus becomes part of the root system and pelotons form.

Orchids as Bioindicators

Orchids need very specific conditions to be present: pollinators, pH, hydrology, fungi, and more. Even common orchids can be hard to find, and they are often among the first species lost from disturbed habitats. **If orchids are present, can be a sign of a healthy environment**

Pollination

Many orchids have evolved to require specialized pollinators. Most flowering plants reward pollinators for a job well done, but about **one-third of orchids offer no reward** and must trick pollinators instead, using:

- **Scent:** sometimes sweet, sometimes foul
- **Visuals:** appealing colors and shapes
- **Mimicry:** looking like female insects

Pollinators and Conservation

Pollinators are critical for orchid conservation. Reproduction in natural populations usually requires specific pollinators, and pollinator populations are declining worldwide.

Researchers haven't yet identified the pollinators for over 50% of native North American orchids.

For orchids with known pollinators, most are known from only a few locations, and pollinators can differ between locations.

More than **80%** have at least part of their range where no known pollinator occurs.

Nighttime pollinators are especially poorly known.

Monitoring many locations is difficult, which slows discovery.

Our partners at SERC have developed **pollinator cameras** that record pollination events and identify orchid pollinators.

Orchids in Minnesota

48 native orchid species in the state

- All are terrestrial.

200 orchid species in the continental US

- Minnesota is a major orchid hotspot in the continental United States

Most grow in wetlands, but some live in prairies and upland forests.

Fun fact: Minnesota's state flower, the showy lady's slipper, is an orchid!

This Year's Experiment

Species: *Goodyera pubescens*, downy rattlesnake plantain, a native Minnesota orchid.

Research questions:

1. Primary Research Question: How does soil type and the presence of fungi affect the survival rate and growth of *Goodyera pubecens* seedlings in a greenhouse setting?
    a. Soil media variable: Does soil type 1 vs. soil type 2 impact *Goodyera pubecens'* growth and survival rate?
    b. Fungal inoculation variable: Do inoculated Goodyera pubescens seedlings grow and survive better than uninoculated seedlings, regardless of soil?

Design: We test two growing media, chosen based on the Plant Conservation Program's practices and the plant's natural habitat. Each soil is tested with and without fungus.

Soil mixes:

Soil 1: Perlite & long-leaf sphagnum (3:1 ratio)

Soil 2: Perlite, compost & cedar bark (3:1:1 ratio)

Components

- *Perlite:* Puffed-up volcanic glass that looks like tiny white foam balls. It keeps soil loose so roots can get air.
- *Long-leaf sphagnum:* A moss that soaks up water like a sponge. It keeps soil damp but not soggy, like the wet spots where orchids grow in the wild.
- *Compost:* Rotted leaves and plant scraps. It feeds the plants and gives fungi something to live on.
- *Cedar Bark:* Small chunks of tree bark. They make air gaps so water drains, and they mimic the forest floor.

Why Are We Doing This?

Why study *Goodyera pubescens*?

It is a native orchid we can grow and observe in the classroom, and it shows the orchid-fungus partnership at work. While *Goodyera pubecens* is not listed as endangered, threatened or under special concern, orchids are generally uncommon in Minnesota. Additionally they serve as bio-indicators for the environment, which is useful to determine if an environment is healthy.

Why add fungus?

Orchid seedlings depend on fungi in nature. Comparing seedlings with and without fungus shows how much that partnership matters for growth and survival in a greenhouse. These seedlings were grown from seed in a nutrient rich solution called agar in the lab, moving seedlings out of the agar and into a greenhouse removes their nutrient supply. .

Why compare two soils?

The best growing medium for orchid seedlings is not well known. Comparing two options helps identify which supports healthy growth. We choose these two mixes because we know that soil mix 1 has been successful to grow orchids in a greenhouse based on our own practices. Soil mix 2 is a slight variation on it, replacing the sphagnum with compost and cedar bark. *Goodyera pubecens* grows in the forest floor of pin-oak-cedar woodlands so cedar bark is appropriate for a closer soil composition to its natural habitat. Finally we add compost to include organic material that supports the growth of the fungus. Fungus need organic materials to consume for nutrients and energy and keep growing alongside the plant. It also helps the fungus stay in place and not get washed off by water. You will find out which soil type helps *Goodyera pubescens* grow when grown without fungus and with fungus.

Why collect data every other week?

Seedlings grow slowly. Measuring every day would give more data points, but it is time-consuming, and changes take time. Regular, consistent measurements are frequent enough to catch change and spaced out enough to show real differences.

Why do we care so much about data?

Tracking what happens lets us see patterns and surprises, repeat or improve the experiment, and expand on what we learned. We can analyze the data, draw conclusions, and, most importantly, share them with other scientists.

Will this make a difference, or is it just a classroom experiment?

It is real science! Careful classroom data on how fungi and soil affect orchid seedlings adds to what researchers know, and it can help guide future growing and conservation work. Many classrooms collecting the same data makes it stronger.

Sources: Plant Conservation Program & North American Orchid Conservation Center (NAOCC)