OREGON DEPARTMENT OF AGRICULTURE AND OREGON ASSOCIATION OF NURSERIES
2020 NURSERY RESEARCH GRANT PROPOSAL

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Funding period: 1 January 2021 to 31 December 2021
Amount requested: $20,000
Title: Hydrogels as novel pesticide delivery system for pest snails in Oregon nurseries

Background and Justification

Slugs and snails are among the most damaging pests of Oregon plant nurseries, and quarantine restrictions for plant materials imported from the Pacific Northwest exist in several U.S. states due to the presence of invasive snails (e.g. *Cornu aspersum*, the European brown garden snail). Snail and slug control is mainly accomplished through chemical molluscicides, the most common of which is metaldehyde. However, metaldehyde has a short field life and its efficacy is highly dependent on environmental factors: baits degrade rapidly under wet conditions, and their efficacy is significantly reduced at temperatures <50°F.

Alginate hydrogels baited with sucrose solutions have been proven to be useful delivery systems for pesticides targeting various ant pests (Tay et al. 2020, *Journal of Economic Entomology*). Hydrogels are highly absorbent polymer matrices that can be "conditioned" to take up aqueous solutions of pesticides, sometimes paired with a liquid attractant. They stabilize pesticides against environmental degradation, increasing their field life, and thus do not have to be applied as often or as broadly as other pesticide delivery systems. They can also reduce pesticide dosage and thereby risk to humans and non-target organisms. Alginate hydrogels are composed of natural polymers derived from algae and bacteria, making them biodegradable under natural field conditions. Because they are easy to deploy and require no further maintenance after application, they can save on labor costs. However, hydrogels have not been considered as pesticide delivery systems for pest snails and slugs.

Project Objective

The objectives of this project are to 1) develop a hydrogel incorporating liquid metaldehyde as its active ingredient, and cucumber, which is a known attractant (Cordoba et al. 2018, *Journal of Economic Entomology*), in the form of juice; and 2) test the efficacy of this bait vs. traditional metaldehyde baits on *C. aspersum* in greenhouse assays.

Methods and Timeline

1. Snail collection and development of hydrogel (Jan – Jun 2021)

C. aspersum will be collected from known infested areas in Oregon, and maintained in colony in the laboratory. Snails will be kept in a clear 18-gallon plastic storage container lined with moistened sterilized soil, and fed a diet of organic carrots, bok choy, and dog food. The snail environment will be kept at high humidity at room temperature.

Project collaborator Jia-Wei Tay, who helped pioneer the use of hydrogels as novel pesticide delivery systems for ants, will supply unconditioned alginate hydrogels in the form of beads for us to work with. The recommended application of commercial liquid metaldehyde (Slug-Fest, OrCal Inc.; 25% metaldehyde by volume) is at a 0.78-7.8% concentration. We will condition the hydrogel beads in the following treatments for initial testing: a) 50% cucumber juice; b) 50% cucumber juice, 0.1% metaldehyde; and c) 50% cucumber juice, 1% metaldehyde. For each treatment, 5 snails will be placed in a plastic container lined with a moistened paper towel and presented with hydrogel beads. Snails will be monitored daily and kept in containers for at least 48 hrs, and feeding will be confirmed by visual observation of the hydrogels. Each treatment will be replicated at least three times. Mortality data will be analyzed using appropriate statistics, e.g. Kruskal-Wallis test followed by Dunn's post hoc test. From these preliminary trials we will determine the attractiveness of alginate hydrogel beads and 50% cucumber juice to *C. aspersum*, and the toxicity of metaldehyde at the tested concentrations. Based on results from these initial tests, we will adjust the concentrations of metaldehyde and cucumber juice accordingly.

2. Greenhouse test of efficacy (Jun – Dec 2021)

Once a suitable hydrogel is developed, it will be tested in greenhouse trials against traditional metaldehyde pellet baits (e.g. Deadline M-Ps, AMVAC; 4% metaldehyde by weight). PI Mc Donnell has dedicated greenhouse space at OSU that will be used for this stage of the project. 10 snails will be placed on the soil surface of five potted plants (i.e. 2 snails per plant) given one of three treatments: hydrogel, Deadline M-Ps, or untreated control. At least five replicates of each treatment will be performed, and treatments will be kept separated in BugDorm insect tents. The number of dead snails will be counted daily for one week or until all snails in the metaldehyde treatments are dead, to compare the effectiveness of the hydrogels with traditional metaldehyde baits. Statistical analysis of mortality data will be performed as stated above.

Benefit to Nursery Industry

Development of hydrogels as a pesticide delivery system for slugs and snails could greatly increase the field life and stability of metaldehyde, the most commonly used pesticide for mollusks. Hydrogels also do not require as frequent of applications as do traditional metaldehyde baits. Another main concern of using metaldehyde baits is their toxicity to mammals (i.e., dogs and cats, but also children if accidentally ingested). Traditional metaldehyde bait pellets are 4.0% pesticide by weight, whereas hydrogels would potentially have lower concentrations and thus less toxicity risk. If baited with cucumber juice, hydrogel baits may also not be as attractive to pets. Finally, alginate hydrogels are easy to deploy and biodegradable, with a natural field life of several weeks.

Budget Summary

Salary – Faculty Research Assistant (0.25 FTE for 12 mo.)	$10,658
Other payroll expenses (for FRA @ 74.5%)	$7,940
Materials and supplies (alginate hydrogels and shipping costs, metaldehyde, potted plants, plastic containers, nitrile gloves, paper towels)	$1,132
Greenhouse space rental at OSU (one quarter @ $270)	$270
Total	**$20,000**