Synthesis of a Soy Protein Hydrogel for Invasive Snail Control in Agricultural Settings

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The island apple snail (Pomacea maculata) is one of the world's most invasive species that poses environmental and agricultural threats. In rice and taro fields, the snails can cause decreases in crop yields and quality, and expose plants to secondary infections. The enzyme papaya proteinase I (papain) can be used as a biochemical control for nonnative snails in laboratory experiments, however this is not replicatable in the field because the enzyme degrades. To resolve this, 20% (w/v) soy protein hydrogels were created by mixing soy protein isolate with distilled water, adding no papain, 0.5g, 1.0g, 2.5g and 5.0g of papain, and then heating all hydrogels at 60°C for 90 minutes. The efficacy of these hydrogels in inducing mortality in invasive snails was determined by exposing groups of snails to the hydrogels for 120 hours. It was observed that groups exposed to hydrogels containing 2.5g or greater experienced 100% mortality, while groups exposed to 1.0g experienced 75% mortality, and groups exposed to 0.5g experienced 55% mortality. A one-way ANOVA was run to determine that these were statistically significant increases when compared to the control. To further test the hydrogels, groups of 20 ghost shrimp (Palaeomonetes paludosus) were exposed to the various concentrations of papain used. It was found that after 72 hours, no shrimp in any of the groups had died after exposure, indicating that other non-mollusc macroinvertebrates were not affected by the presence of the enzyme. The biodegradable soy protein hydrogels developed in this study can provide economically feasible and environmentally sound ways to eradicate invasive snail populations in agricultural areas and provide a framework for further refinement and eventual usage in environmental settings as well.

Awards Won:

Intel ISEF Best of Category Award of $5,000