RESEARCH IN PROCESS

Engineering and ecological approaches reduce Pacific tree frog intrusion into leafy green agriculture

SUMMARY

It's no secret that consumers expect perfection. In the case of fresh produce, consumers expect a product that is safe for consumption and visually appealing. Unfortunately, the Pacific tree frog, also known as the Hollywood frog, is challenging the leafy green production environment with its high reproductive capacity and extraordinary ability to scale traditional exclusion fences. We are using information at the intersection of Pacific tree frog biology and agricultural engineering to mitigate tree frog intrusion into production environments. Our approach is multifaceted, with the overall aim to provide producers with several options to reduce frog intrusions. We intend to provide data on a variety of exclusion methods, which will ultimately allow producers to tailor mitigation efforts to their own unique growing situation.

OBJECTIVES

1. Test novel drift fence designs and test non-toxic deterrents to determine whether placement of chemicals or physical materials coupled with improved fence design improve frog exclusion.
2. Test optical sorting and field identification potential of thermal imager.
3. Test the efficacy of noninvasive acoustics to redirect frogs away from water sources that are near/adjacent to agricultural fields.
4. Determine the comparative risk of frog intrusion in different production environments.

RESULTS TO DATE

At the outset of the project, our team visited field sites and selected several irrigation ponds for frog surveys. Each field location provides a unique set of characteristics that may influence frog populations, including access to natural areas, type of cover, irrigation type and schedule, produce variety, and harvest method. Furthermore, the field conditions were taken into account in order to develop a method to test the durability of the fence designs. We used data collected during these advanced surveys to guide our experimental design for fence designs, fence tests, and frog surveys.

BENEFITS TO THE INDUSTRY

Leafy green growers will benefit directly by gaining validated methods to prevent Pacific tree frogs from entering fields. A reduction of frogs will reduce the loss of fresh produce due to safety concerns and will reduce the accompanying financial burden that can be associated with frog intrusions. Following the field-to-market chain after the leafy greens fields, stakeholders involved in the processing, packaging, and sales of leafy greens will also benefit from decreased frog intrusions. Reports indicate that a single Pacific tree frog intrusion can cost a grower in the range of hundreds of thousands of dollars. Extrapolation of this estimate across the Salinas Valley of California and other parts of the Central Valley can easily put the financial impact in the millions of dollars, and thus our findings will have an immediate and positive economic impact for the fresh produce industry.

METHODS

Tree frogs can scale traditional fences using their toe pads; however, rough surfaces can prohibit their ability to stick. We will design and construct biologically inspired fences to inhibit the climbing ability of tree frogs. We will test new fences for durability using wind-tunnel trials and, in the field, during strong wind events. We will use visual-encounter surveys and passive trapping for tree frogs to determine which sites pose the highest risk of intrusion. To assess fence inhibitory properties, we will construct arenas near irrigation ponds, and captured frogs will be tested in arenas such that fences will have to be scaled to return to their pond. We will test the efficacy of sensitive thermal imaging technology as a means to detect frogs in leafy green production environments. Lastly, we will use playback recordings of male tree frog calls to assess whether females can be redirected away from crop fields.

Figure 1. Tailwater pond adjacent to natural wetlands and agricultural fields.

Figure 2. Traditional silt fence exhibiting wind damage, originally installed to exclude frogs and other wildlife from the growing environment.

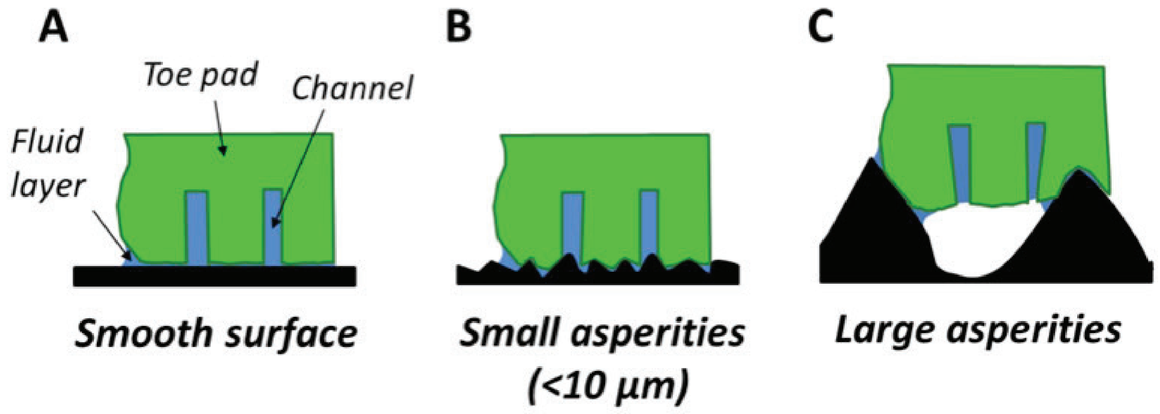

Figure 3. Image from Crawford et al. (2016) predicting frog toe pad contact on rough surfaces. Toe pads easily contact smooth surfaces (A) or conform to rough surfaces with small (B) and large asperities (C).

Reference: Crawford N, Endlein T, Pham JT, et al. (2016) When the going gets rough – studying the effect of surface roughness on the adhesive abilities of tree frogs. Beilstein J Nanotechnol 7:2116–2131. doi: 10.3762/bjnano.7.201

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