10 Finalists

Emerging Pathogen and Pest Toolbox

Niklaus Grunwald, Rex Nelson, Monica Poelchau, Gerard Lazo, Frank Martin, Matt Rouse, Surya Saha, Jeff Chang, Melodie Putnam, Dave Gent, Carlos Suarez

Disruptive pests and pathogens emerge at an accelerated pace globally affecting agriculture, forests and ecosystems. Each (re)emerging pest or pathogen is unique and scientists typically redeploy a range of ad hoc tools for diagnostics and management. Sequencing costs now around $10-100/sample will decrease substantially over the next decade. The bottleneck is thus sample analysis and interpretation. Current genomic databases are not user-friendly or targeting diagnosticians. The Pest & Pathogen Preparedness (PPP) Platform is disruptive, innovative, scalable and allows rapid identification of pests and pathogens for early detection and enhanced resilience. Crowdsourcing of pest and pathogen data over space and time (analogous to a digital herbarium) further facilitates discovery of novel adaptive mutations using tools such as artificial intelligence.

Topical Application of Double-Stranded RNA for Weed Suppression

Matthew Tancos, Michelle Heck

A limited number of cost-effective options are available to manage widespread weed infestations over large, inaccessible, and ecologically sensitive natural environments that are vital to wildlife, agricultural, and urban needs. Therefore, investigating innovative, high-risk solutions that take an entirely different approach to weed management, i.e., host-specific, sustainable, environmentally safe, and effective, are crucial. The goal of our research plan is to develop a genetically-tailored weed control strategy that leverages advances in RNAi technology through the development and deployment of exogenous double-stranded RNA as a species-specific RNAi-based bioherbicide.

Novel Feed-Based Therapeutics for Honey Bees

Vincent Ricigliano, Michael Simone-Finstrom, Kate Ihle, James Thomson, Tyler Williams

Pathogens and malnutrition are two major interacting stressors of managed honey bees. We are developing novel Single Cell Protein (SCP) diets of edible microbial biomass to provision bee colonies during periods of forage scarcity or prior to agricultural pollination services. SCPs have excellent nutrient profiles, capacity for sustainable mass production, and are amenable to synthetic biology applications. Hence, we have begun engineering SCPs for the delivery of edible vaccines to improve honey bee pathogen resistance. End users (commercial beekeepers) could easily incorporate nutritious SCPs into bee feeds for distribution of feed-based therapeutics to large numbers of colonies.

Accelerating Production of New Biological Control Agents of Weeds

Lincoln Smith, Ikju Park, Thomas Coudron, Franklin Arthur, William Morrison, George Yocum

Classical biological control, the use of host-specific natural enemies, is a highly effective, economical and environmentally-benign method to control invasive plants. However, many of the insect agents for invasive weeds in temperate climates have only one generation per year, which makes them very slow to multiply, delaying their impact for many years, even decades. We propose to use methods from other research fields to break diapause and produce multiple generations per year to increase the release of insects by more than 1000 fold. These methods should be applicable to other biological control agents, which would revolutionize this management strategy.

Handheld Device for Assessing Plant Health

Cheryl Armstrong, Joseph Capobianco, Yongping Duan, Wan Shih, Wei-Heng Shih

Huanglongbing is a devastating citrus disease with no known cure. It's spread by an insect present in most citrus-producing areas of the US. Therefore, locations like California that do not presently have the disease in commercial groves are on high alert, spending millions of dollars annually for prevention. Early disease detection can help identify efficient strategies for deploying the limited resources critical for effective containment. The current industry standard for detection involves a lab-based real-time PCR method. To aide producers, we propose to develop a device that can be utilized in the field for early detection of Huanglongbing. The device can potentially be used to screen trees on-site to more effectively identify areas that merit further evaluation.

Reversible Biocides

William Hart-Cooper, Paul Pratt, Jennifer Wilson-Welder, Jong Kim, Xiaohua He, Kaj Johnson, Erica Schapiro, James McManus, Luisa Cheng

Inspired by the diverse array of functions found in nature, we propose a platform of simple, inert ingredients that self-assemble to highly potent biocides. These active ingredients are linked together by reversible bonds that are broken when the substance is diluted in water, minimizing toxic effects and their unintended consequences, such as biocide resistance. The innovation has usefulness for microbial pathogen prevention and food safety, biobased cleaning and personal care products, livestock health and insect control.

Delivering Real-Time Crop Pest/Pathogen Immunity

Robert Shatters, Rodney Cooper, Michelle Heck, Jim Thomson, Cindy McKenzie, Randy Niedz, Cristina Pisani, Marco Pitino, Ed Stover, Wayne Hunter, Magai Grando, Joseph Krystel, Lorenzo Rossi, Dan Gibson, Taw Richardson, Kent Morgan, Joseph McIntyre, Mark Trimmer

We present a real-time “immunization” method to modify plant traits including, but not limited to, those to fight pest/pathogen attacks. Transgenic and genome editing of the whole plant genome are not required.

Eradication of the Cattle Fever Pathogen, Babesia bovis

Brian Rector, Glen Scoles, Susan Noh, Carlos Suarez, Massaro Ueti

We propose to determine whether the southern cattle tick, Rhipicephalus microplus, can be transformed using Crispr-Cas9 to express a destructive, “suicidal” gene when the tick is exposed to the pathogen that causes cattle fever, Babesia bovis. We plan to insert this destructive gene under the control of a promoter that is induced by B. bovis presence in wild-type ticks. The first step toward this goal will be to demonstrate that R. microplus can be successfully transformed with a Crispr-Cas9 construct containing a marker gene, resulting in super-mendelian inheritance of the construct.

Receptor Interference Technology for Novel Insecticide Discovery

Man-yeon Choi, Jana Lee, Bob Vander Meer

The technology works by selecting peptides that interfere with target receptors, blocking specific physiological functions. Proof of concept was achieved with the identification of bioactive peptides having insecticidal effects on fire ants and slugs. Isolation of bioactive peptides can be achieved in as little as 3 weeks. Thus, novel insecticides can be quickly available for new or established invasive pests.

Enhancing Plant Immunity to Necrotrophic Pathogens

Weidong Chen, William Underwood

This innovation seeks to capitalize on our recent discovery of a fungal virulence factor (ie. effector) that disarms a universal cell wall defense protein, a component of plant innate immunity. Our recent research showed that broad host-range pathogens notorious for causing maceration of infected plant tissues secrete the defense protein-binding effector, counteracting plant basal defense. This innovation aims to design an improved defense protein that can evade binding and interference by the fungal effector and enhance plant immunity. Since this defense protein is highly conserved among plants, this innovation could be applied to a wide range of crops to reduce disease and increase yield.

Questions?

Contact arsx@conservationxlabs.org