ARSX2020 - Stopping the Next Disruptive Species

THE COMPETITON

Disruptive pests and pathogens, especially invasive ones, are a major threat to biosecurity (Meyerson and Reaser 2003), adversely impacting the economy (Bradshaw et al. 2016), natural and cultural resources (Young et al. 2017; Drake et al. 2016; Simberloff et al. 2013), infrastructure (Invasive Species Advisory Committee 2016; Connelly et al. 2007), human health (Young et al. 2017; Bradshaw et al. 2016), and agricultural production (Bradshaw et al. 2016). In the United States, invasive species alone cause environmental damages and losses to native and agricultural ecosystems adding up to more than $120 billion per year, about one third of this cost is in crop and forest production losses (Pimentel et al. 2005)[1]. Climate change further accelerates and amplifies disruptive species issues by creating new environments where species expand their range and thrive where they previously could not thrive.

Perhaps paradoxically, many modern agricultural practices and food systems have spurred the proliferation of disruptive species. The creativity that enabled these technological advances can also provide powerful techniques for managing them. Prevention is the ideal approach to combatting disruptive species. When a disruptive species moves into a new habitat, due to the self-perpetuating nature of these invasions, there is a narrow window of opportunity for detection and successful eradication or management of an invasive species. Yet there are a number of possible ways to combat disruptive species. The goal of ARSX is for ARS scientists to generate novel and powerful technologies for predicting, preventing, detecting, controlling/or eliminating disruptive species, either as a whole or as a distinct subset.

With over 2,000 Ph.D. research scientists focused on agriculture distributed throughout the United States, ARSX is an opportunity to harness your expertise and knowledge within ARS to innovate and invent, to propose new ideas that will prevent and eradicate disruptive agricultural pests and pathogens.

ARSX seeks your ideas and innovations that will contribute to the prevention, detection, and eradication of invasive species, disruptive pests, and pathogens in agricultural ecosystems:

1. Stopping Invaders at the Gate – innovations that can **prevent the introduction of or provide early detection** of invasive and disruptive pests and pathogens on agricultural ecosystems.

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[1] See Table 1 in Pimentel et al. 2005.

2. Strengthening Immunity – innovations that confer **resilience** to disruptive pests and pathogens among agricultural crops and animals.

3. Eliminating the Threat Within – innovations that can lead to **eradication** of invasive species, disruptive pests and pathogens without negative impacts on the environment and humans.

4. Futures Prediction – innovative methods to **predict the future** invasion of disruptive pests and pathogens due to climate change and make it available to American farmers in an accessible manner through publicly available datasets (i.e. camera traps, social media feeds, citizen scientist generated, GIS, satellite, etc.)

Problem Background

A disruptive species is any organism that is harmful to the functional ecology of a system and to which we are unprepared to respond – it could be a non-native invasive species, or a native species that has extended its range due to a newly favorable habitat or climate. Disruptive species are of critical importance across most agricultural commodities, most regions of the country, and many sectors of animal and public health.

Disruptive plants destroy rangelands, reduce production of grazing animals, infiltrate cultivated fields and interfere with agricultural processes such as harvest and processing. Disruptive animal species can destroy ecosystems, decimate crops, and interfere with animal production. Disruptive parasites and microorganisms reduce efficiency and cause disease. Disruptive species extend to the microbiome of animals, humans and even soil where non-native populations of microorganisms may cause physiologic and metabolic disruption and dysregulation.

A disruptive species may originally be present in an ecosystem in only a small and controlled population, however a changed environment may suddenly allow that species to explode exponentially to radically alter the ecology. Disruptive species may also be new to ecosystems, as in the case of non-native invasive species.

We always expect another incident, and now we seek to stop it before it devastates our food, fiber or public health. Examples include invasive pests, emerging pests and diseases, and antimicrobial resistant pathogens.

Citations

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