Emerging and Re-emerging Plant Diseases

Improving our current system of plant health monitoring and quarantine at national and state borders.

Plant diseases are a perpetual threat to the health and productivity of agricultural crops, forests, rangelands, landscapes, and natural plant ecosystems. This threat is increasing due to a rise in emerging and re-emerging plant pathogens. For example, wheat blast is an emerging disease that is devastating wheat production in areas of South America, and if it arrives in the United States, such as on contaminated seeds, it has the potential to devastate U.S. wheat production and result in economically harmful quarantines. The extensive global trade of agricultural products is fueling opportunities for short-, medium-, and long-distance movement of plant pathogens as well as insects that transmit pathogens. Changing regional and global climatic conditions are driving changes in the geographic distribution of plant diseases. In addition, new plant pathogens are emerging when organisms adapt to new plant hosts or cultivars, and existing pathogens are re-emerging following the development of chemical resistance or changes in agricultural management practices and plant varieties.

A multifaceted approach is needed to prevent pathogen introduction, minimize pathogen movement across national and state borders, and meet the ongoing challenges posed by new and re-emerging pathogens. This approach requires:

- An effective monitoring and surveillance system;
- Rapid and accurate diagnostics;
- Predictive knowledge of the risk of pathogen introductions; and,
- The development of effective prevention and mitigation measures.

Collectively, these steps are needed for science-based phytosanitary rules, redesign of trade agreements and prevention of disease epidemics that threaten the productivity of U.S. agriculture.

Effective surveillance for pathogens in seeds, pollen, rootstocks, nursery stocks and other propagative plant tissues requires sensitive and accurate pathogen detection as well as an understanding of the biological relevance of the detection results. Molecular detection tools are sensitive and powerful. However, they must be employed with adequate knowledge, as they can detect dead cells and very low numbers of pathogens, which may or may not pose a threat to agriculture. The economic costs of potential false positives often are not known but are quite real, as are the risks associated with false negative tests. The complex interactions within phytobiomes involving seeds and other propagative materials, that is between the plant, the associated microbial communities and the environment, highlight a critical need to understand how these interactions impact the risk of subsequent plant disease. Collectively, increased knowledge and data on these interactions can be translated to an understanding of true risks and robust, science-based regulations. Moreover, knowledge of the agricultural practices and evolutionary mechanisms that drive the emergence of new and re-emerging pathogens will support strategies to prevent or mitigate their development and establishment.

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Solutions

Increased funding in the following areas will improve our ability to reduce the threat of these plant pathogens:

- Applied research to **improve testing of seeds and other plant propagation materials** by developing a better scientific foundation to exploit molecular tools for detection, to relate knowledge of plant microbiomes to pathogen risk and subsequent plant health, and to translate this knowledge to public- and private-funded plant tissue testing.
- Fundamental research to **improve our understanding of pathogen evolution, spread and response** to other components in the phytobiome to help predict risks more effectively and minimize and mitigate plant disease epidemics.
- Public microbial culture collections, which require significant capacity building in the form of increased staffing and technical facilities to ensure the **long-term availability of culture collections** as a resource for biological and agricultural research and the industries this research supports.
- Sustained and effective surveillance for pathogen emergence via increased **support for the National Plant Diagnostic Network**.
- Enhanced **student and postdoctoral preparation** for entering the workforce that includes opportunities for broadening experiences in agricultural industries and public and private systems involved in plant and seed health testing, surveillance, and regulation.