Testimony

Federal Research and Development for Agricultural Biodefense

Addendum

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The RAND Corporation[2]

Addendum to testimony before the Committee on Science, Space, and Technology
Subcommittee on Research and Technology
United States House of Representatives

Submitted December 5, 2017

Question for the record from Barbara Comstock: How are the results of federally supported agriculture research transferred to U.S. farmers? Is the transfer efficient and effective? What improvements might be needed?

Daniel Gerstein: Research and development must be thought of as a system that includes federal, state, and local governments in collaboration with private industry to identify requirements for federally supported research and development (R&D), fund the highest priority programs, and transition the R&D products to the user community. During my tenure in the Department of Homeland Security (DHS), where our focus was on agricultural biodefense, the R&D products included a wide range of prophylaxis, diagnostics, and knowledge products that support the development of policies, programs, and activities to support and protect a healthy and vibrant agricultural sector.

This implies that government and industry stakeholders must be in close coordination and have a free flow of information about the biological threats, vulnerabilities, concerns, and requirements to ensure that federally funded R&D is focused on the highest priority issues. It also implies that federal support for key R&D programs and facilities is available. Key to ensuring the successful transfer of federal R&D are unique facilities, such as the National Bio and Agro-Defense Facility (NBAF) in Manhattan, Kansas, or federally led efforts, such as the National Animal Health Laboratory Network, which has its roots in the Homeland Security Act of 2002 and Homeland Security Presidential Directive 9.

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The transfer of federally-funded R&D has had demonstrated success. One such example is the federal funding and support for early R&D for development of a foot-and-mouth disease (FMD) vaccine. The U.S. Department of Agriculture (USDA) and the DHS initially led efforts to develop a vaccine. Government and industry identified the requirement; academia provided some of the early science; and a vaccine developer, through a cooperative R&D agreement with DHS, licensed and manufactured the vaccine. The result was an approved vaccine that is now commercially available.

While the FMD vaccine example demonstrates how the system can work, more collaborative efforts such as this are needed. Continued cross-talk will be required across the agricultural biodefense stakeholder community to ensure an alignment between community requirements and funded programs. In this regard, consistent funding for agro-biodefense is also essential to ensure that the highest-priority R&D is appropriately funded.

Question for the record from Barbara Comstock: What areas of R&D would be most important to strengthen the nation's position in global food exports and to help provide U.S. farmers a competitive edge in meeting future food needs and market demands?

Daniel Gerstein: Increased demands for food, coupled with climate change stresses, will translate to greater requirements for R&D to produce generations of crops and livestock that produce more per unit area under more-extreme climate conditions and in harsher environments. It will also require R&D to support important agricultural biodefense capabilities.

No single technology or R&D area is sufficient to protect the $1 trillion-per-year agricultural sector. We need a combination of capabilities for preventing, mitigating, protecting from, responding to, and recovering from an agriculture biodefense event (either naturally occurring or deliberate) to support and protect the U.S. agriculture sector. This combination not only protects the food supply for U.S. producers and consumers but also supports a healthy and vibrant U.S. food export capability.

Threat awareness remains essential for protecting the nation’s agricultural sector. Understanding the range of threats—from naturally occurring disease to the deliberate use of biological pathogens—allows tailoring R&D towards the highest-priority concerns. Prevention and protection programs, such as vaccine programs and international efforts to halt the spread of disease (through a variety of programs, including biosurveillance and reporting, arms control, and export controls), should receive high priority in R&D. Surveillance and detection remains essential for monitoring the agricultural sector. Improved bioassays, pen-side diagnostics, agricultural screening tools, and surveillance and reporting capabilities and the associated R&D are essential as well. Response and recovery R&D, including response planning, development of rapid response capabilities, and depopulation protocols would be essential in the event of an outbreak or an attack.

In looking to the future, biotechnology is continuing to increase at unprecedented rates. New tools and technologies are continuing to be introduced. Gene editing, genomic selection, deployment of transgenes, and high throughput sequencing—to name a few areas—have the potential to significantly alter agricultural yields and reduce susceptibility to a wide range of

natural threats (including climate change) and deliberate threats. R&D must continue to ensure that the United States maintains a competitive edge for meeting market demands and in agricultural exports.

Question for the record from Barbara Comstock: What areas of research and development would you suggest be prioritized in the next farm bill?

Daniel Gerstein: While agricultural R&D is a broad area with many requirements, activities that support the U.S. agricultural industry's capacity to deal with importation of new diseases, changing climate, and increasing global demand should receive priority. Growth in global trade and travel means that humans, animals, plants, and microbes are more likely to be introduced into the United States. Protecting the U.S. agricultural system means developing threat awareness and surveillance and detection systems to support rapid response and recovery systems.

Changing climate and increasing demand (particularly for protein) will require being able to increase yields using less water and land. By 2050, the requirement for food production will increase by an estimated 70 percent. R&D has a pivotal role in delivering these requirements.

Question for the record from Barbara Comstock: Lots of remarkable new technology is right around the corner and seems bound to change farming: drones equipped with advanced sensors; autonomous planting and harvesting equipment; computers and smart machines to calculate when and how to plant, irrigate, fertilize and harvest. What do you foresee as technologically advanced farming?

Daniel Gerstein: The increased demands for food, coupled with climate change stresses, will translate to greater requirements for R&D to produce generations of crops and livestock that produce more per unit area than current varieties, under more extreme climate conditions and harsher environments.

Genetically modified organism (GMO) technologies and the associated R&D offer important opportunities for improving yields in harsher climates. However, the current debate about GMOs unnecessarily focuses on the technology, rather than on the products that it supports. Regulations should focus on promoting ethical and scientifically based improvements that are carefully managed to avoid potentially dangerous outcomes.

New modes for enhancing agricultural output and protecting the environment will continue to be incorporated. Substitution of biological materials for chemical fertilizers and vector control is occuring with increased regularity, and these uses will continue to expand. Reducing the use of antibiotics in agriculture will also be important for reducing antimicrobial resistance in animals and humans.

Question for the record from Barbara Comstock: What roles should the federal government, states, academia, and private sector play in agricultural research? Is one entity better suited to conduct certain types of research (for example, basic research versus applied research)?

Daniel Gerstein: The federal government, states, academia, and private sector each play important roles in agricultural research. The point is to develop a collaboration between the various actors to ensure that all critical R&D is being conducted to the betterment of the U.S. population and agricultural sector. Such collaboration also strongly implies close collaboration across the globe in the monitoring of disease and the conduct of R&D activities.

Allocating roles to each of the entities in an absolute sense is not possible. Government, academia, and the private sector conduct R&D across a broad spectrum of activities. Private industry, academia, and federal laboratories (such as NBAF and the Department of Energy labs) conduct basic and applied R&D, from early research to increase fundamental understanding of certain phenomena to developmental activities to monetize their work and improve outcomes. The government has a primary role in coordinating activities in particular areas, such as agricultural biodefense; developing policies and regulations; developing codes of ethical behavior, biosafety and biosecurity; and monitoring compliance.

However, in certain circumstances, such as the development of the FMD vaccine, government, academia, and industry work together to develop a needed capability. Government and academia provided much of the early research and development. Private industry, through a cooperative R&D agreement, collaborated with government to bring the vaccine to market.

In cases involving genetically modified organisms, industry is working to develop drought-resistant crops and livestock that yield more protein. Industry routinely partners with academia on these efforts.

The government (at all levels) has unique roles in disaster management and emergency situations. For example, in the event of an FMD outbreak in the United States, the government would have an active role in monitoring the response, particularly in areas such as depopulation and disposal of the infected remains.

The difficulty in establishing discrete roles for each of the entities involved in agricultural biodefense provides indication of why close collaboration of R&D efforts is essential. Through this collaboration, the highest-priority issues can be examined and gaps in agricultural biodefense R&D addressed.

Question for the record from Randy Hultgren: Do you think USDA is properly leveraging Department of Energy (DOE) Office of Science facilities and other investments at our national labs? How can we better facilitate a more collaborative approach between different agencies so we are doing the best science and not duplicating efforts and facilities?

Daniel Gerstein: The agricultural biodefense stakeholder community consists of government, the federally funded R&D centers (FFRDCs), academia, and private sector. The DOE laboratories are FFRDCs that provide a broad range of R&D activities, from basic research to development.

Each of the stakeholders play important roles in agricultural biodefense research. The point is to develop collaboration between the various actors to ensure that all critical R&D is being conducted to the betterment of the U.S. population and agricultural sector. Such collaboration

also strongly implies close collaboration across the globe in the monitoring of disease and the conduct of R&D activities. Through this collaboration, the highest-priority R&D issues can be examined and gaps in agricultural biodefense addressed.

While the stakeholder community works with the DOE national labs in agro-biodefense R&D, I do not have specific knowledge of ongoing programs between USDA and the national labs. However, during my time in DHS, we maintained close relationships with the labs to ensure we were doing the best science and minimizing or eliminating duplication of efforts and facilities.

Question for the record from Randy Hultgren: With regard to research on microbial communities in soil, plants and animals, does USDA have any plan to focus on the use of engineered microbial communities for soil and seeds to increase drought resistance or lower inputs?

Daniel Gerstein: I have no information regarding specific USDA programs for development or use of engineered microbial communities for soil and seeds to increase drought resistance or lower inputs.

However, the increased demands for food, coupled with climate change stresses, will translate to greater requirements for R&D to produce generations of crops and livestock that produce more per unit area under more extreme climate conditions and in harsher environments.

GMO technologies and associated R&D offer important opportunities for improving yields in harsher climates. The search for identifying opportunities for enhancing agricultural output and protecting the environment will continue, and USDA has a central role in these efforts.