Proceedings of the 2010 AAAS Charles Valentine Riley Memorial Lecture

Agricultural Research: Changing of the Guard, Guarding the Change

Co-sponsored by the Charles Valentine Riley Memorial Foundation in collaboration with the World Food Prize Foundation

"to promote a broader and more complete understanding of agriculture as the most basic human endeavor and...to enhance agriculture through increased scientific knowledge"

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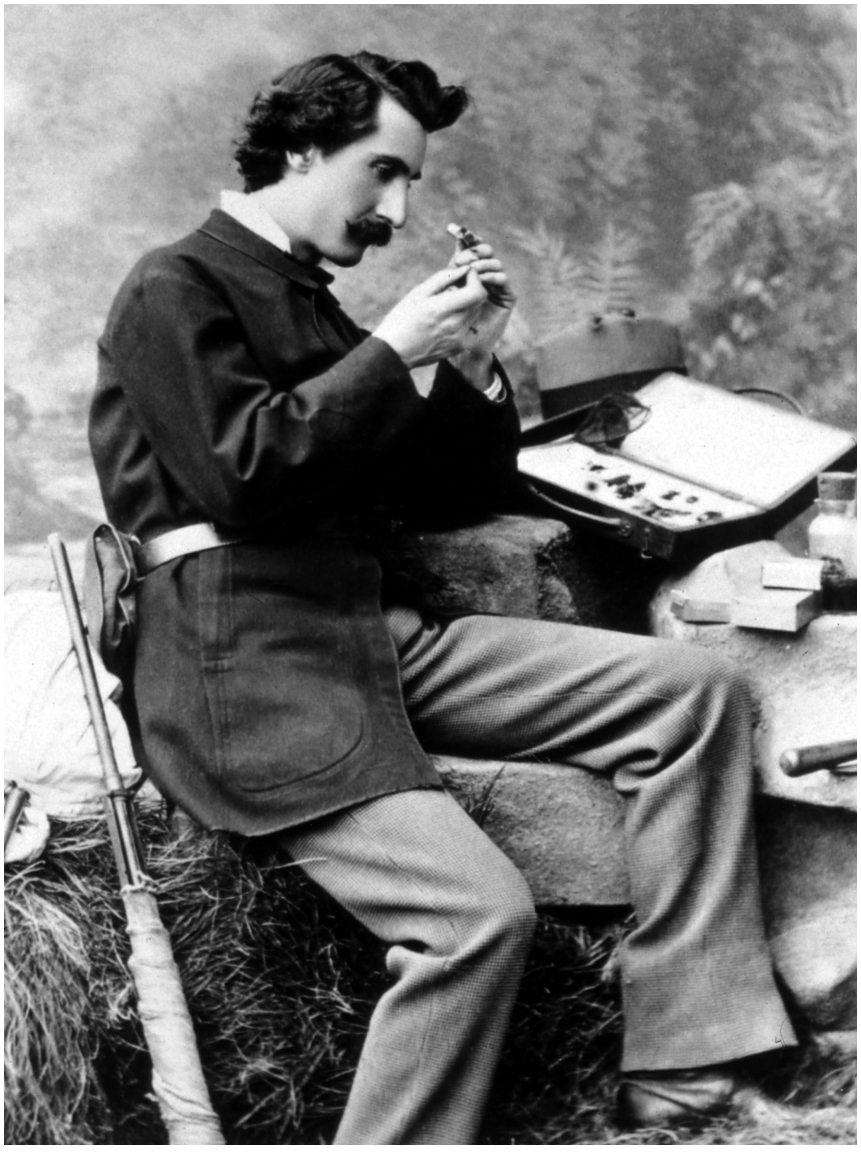

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Foreword

Today, we face the growing challenge of how to feed the over 6 billion people living on this planet. Many regions remain vulnerable to limited food production and availability leading to chronic hunger, malnutrition, or the constant threat of famine. Growing global populations will only place greater pressure on the system. In fact, by 2050 food production will need to double to meet this increasing demand.

But while the challenges are real, there is cause for optimism as well. We have seen in the past how new agricultural techniques and technologies have been employed to increase production. Norman Borlaug – the inspiration behind the Green Revolution – gave hope to billions of the world's undernourished and stimulated tremendous progress in agricultural research and its applications. Building on this tradition, many voices in science and food policy have again focused on the need for a "next generation green revolution" – to provide food and sustenance to the next generations.

The global science community has a central role to play in such efforts. To help implement that role, AAAS has recently increased its level of activity in agriculture and agricultural research, recognizing that improving food production, delivery, safety, and security are central to enable people throughout the globe to thrive and survive.

Today the issue of food production comes with many related challenges, including the need to balance factors such as access to reliable energy sources, water quality and availability, soil productivity, and the impacts of climate change on harvests. Scientific research and knowledge is central to these efforts as well.

Our commitment to advancing agricultural science has been strengthened by our relationship with the Charles Valentine Riley Memorial Foundation, which in 2008 made a gift to endow the Charles Valentine Riley Memorial Lecture at AAAS in honor of Professor Riley's legacy as a "whole picture" person with a vision for enhancing agriculture through scientific knowledge. The goal of this lecture is "to promote a broader and more complete understanding of agriculture as the most basic human endeavor and ... to enhance agriculture through increased scientific knowledge," addressing timely topics such as the role that food, agriculture, and natural resources play in providing for a secure food supply and a sustainable economy. Given the importance of these issues, we were pleased to join our colleagues at the Charles Valentine Riley Memorial Foundation and the World Food Prize Foundation to plan the 2010 AAAS Charles Valentine Riley Memorial Lecture.

The world has high expectations and tremendous needs, but we have great confidence in the ability of researchers to increase knowledge and in our policy makers to make transformative changes in the field of agriculture so that we can meet the challenge of feeding this and future generations.

Alan I. Leshner
CEO, AAAS and
Executive Publisher, *Science*

Acknowledgements

This year's lecturer was chosen by a distinguished Selection Committee. We are grateful for the time they spent reviewing the nominees and are honored that they selected as Lecturer such an eminent spokesperson for agricultural science. We would like to thank the committee members for their efforts:

Daniel Bush
Professor and Chair in the Department of Biology, *Colorado State University*
Retiring Chair, *AAAS Agriculture, Food, and Renewable Resources Section*

Daniel Dooley
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Member of the Board on Agriculture and Natural Resources, *National Academy of Sciences*

Ambassador Kenneth Quinn
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Richard Ridgway
President, *Charles Valentine Riley Memorial Foundation*

Vaughan Turekian
Chief International Officer, *AAAS*

We would also like to recognize and thank the following sponsors for their generous support of this year's lecture:

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Norman Borlaug Institute for International Agriculture Texas A&M University System

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Lecture and Response Panel Summary

Roger N. Beachy, Director of the National Institute of Food and Agriculture (NIFA)

During remarks marking the inaugural AAAS Charles Valentine Riley Memorial Lecture, Roger Beachy suggested that after decades of benefiting from past investments in agricultural science, the United States now faces a watershed moment in which it must move beyond the "arrogance of plenty."

Farmers have used conventional breeding practices to make huge strides in crop and animal productivity over the years. But that will not be enough in a world where food production likely will have to double by 2050 to meet the demands of rising global population, he said. Americans and others in the developed world have taken for granted the bounty they enjoy.

"Because we do not feel the hunger that gnaws at nearly a billion of the world's citizens and because the few American farmers that feed America and much of the world are often out of sight and out of mind of urbanites," Beachy said, "we have become complacent in the support and advocacy for agriculture research."

Beachy discussed what he calls an "arrogance of plenty," in which we give little or no thought to whether there will be food tomorrow in the supermarket, or fiber for clothes, paper for books, or lumber for home construction. But that bounty is not limitless.

"We are most assuredly living on the fruits of past investments, some of them going back generations." The U.S. Department of Agriculture was established by President Abraham Lincoln as an agency with a focus on science. America's land-grant colleges and universities helped create "the most productive agricultural system this Earth has ever known," Beachy said.

With the exception of a few bright spots, Beachy said, federal funding for agricultural research has been declining or stagnant for decades, threatening the future health and wealth of rural communities as well as the nation's long-term food security. Industry has picked up some of the slack, he said, but much of the private sector funding for agricultural research "is focused on relatively short-term, high-impact outcomes that will support product lines" and benefit the bottom line.

"This seems to me a mistake at a time when funds are so badly needed to advance a fundamental understanding of the organisms on which the science of agriculture and sustainability are based."

He noted that industry has the potential to do more. Producers of agricultural commodities such as milk, pork, beef, eggs, potatoes, and honey contribute more than $645 million annually to a mandatory assessment program called commodity checkoffs. The great majority of the money now goes to marketing and promotion rather than research.

With transformative change underway in agricultural research—driven largely by advances in biotechnology—Beachy argued that only the federal government is in a position to help fully exploit that change with forward-looking research grants.

He acknowledged the tight budget climate but said he is determined not "to preside over a flat budget and a research paradigm more suited to the 19th century than the 21st century."

The Obama administration has proposed a 63 % increase in the 2011 fiscal year (to $429 million) for the Agriculture and Food Research Initiative, NIFA's main funding mechanism for competitive research grants.

"We must and we will advocate for strong funding," said Beachy, who formerly led the Donald Danforth Plant Science Center in St. Louis and was appointed as the first director of the newly established NIFA in October 2009. He is a member of the National Academy of Sciences, an elected Fellow of AAAS, and is known for his groundbreaking research on developing virus-resistant plants.

To address the agricultural challenges of the 21st century, Beachy said, there also must be a realignment and revitalization of research programs. He cited some of the recommendations of a 2009 National Research Council report on "A New Biology for the 21st Century" in calling for a unified research approach that addresses big, bold questions.

Barriers between academic departments and between different college campuses and laboratories must be removed, Beachy said. In place of the current emphasis on individual investigators, he urged more team-oriented research that combines the talents of engineers, biochemists, geneticists, crop and animal scientists, specialists on food processing, and others.

As an example, a team might tackle the puzzle of why nutritional status can vary so widely from person to person. The answer likely will come by knowing the genetics of individuals, the diversity of the microbes in their intestinal tracts and how diet affects the metabolism of those microbes in releasing nutrients we absorb. Such a project might call on the sciences of human genomics, nutrition, microbial genomics, population biology, plant genetics, and biochemistry, Beachy said. The outcome could be de-

velopment of crops and foods that are optimally matched for individual health and well-being.

"How long before we'll go down the food aisle with a barcode [device] that knows our genetic composition and the biochemical composition of the foods on the shelves?" he asked, "allowing us to select foods that lead to better health and well being."

Since solving such problems will require scientists from many disciplines, it "clearly will not be business as usual at USDA." The transformation also will require changes in how science is performed at the nation's research universities. "We have to move away from agricultural research as an entitlement program." Earmarking of small amounts of money for specific researchers or universities to address specific local problems does not serve national goals, Beachy said.

In addition to more emphasis on goal-oriented, team-focused research, he said, universities also must find ways to "reward faculty for their interactions rather than their independence."

Researchers who seek NIFA-funded competitive grants also should be prepared to focus on target areas the agency has identified, including food production and sustainability; biofuels, climate change and the environment; food safety and nutrition; and global food security. And it is essential that the practical results of NIFA-funded research grants find their way into the real world of farmers and consumers.

Response Panel

Molly Jahn

Dean of the College of Agricultural and Life Sciences at the University of Wisconsin-Madison

Molly Jahn who moderated the discussion panel, used her brief opening remarks to set the stage for the broader discussion. She agreed with Dr. Beachy that agricultural research is at a pivotal moment, not only to help ensure food security but also to address some of the climate-driven changes in planetary ecosystems that will affect food production. "This is no time to coast," she said.

Neil Conklin

President of the Farm Foundation

Neil Conklin stated that farmers have "a long history of innovation and of appreciation for the power of science." Despite that, he said, farmers also have had ambivalent attitudes toward science, with a focus by most farm organizations on how to maintain and boost incomes rather than on research.

That has been changing, Conklin said, with a realization by farmers that a strong research effort will be needed if agricultural output is to double by 2050. Farmers understand that without research "you're going to slide backward." He added that most new farmers today are college-educated and have the ability to take on evermore sophisticated levels of technology. That, too, will drive interest in and support for agricultural research.

Gebisa Ejeta

Distinguished Professor of Agronomy at Purdue University

Internationally, there also is a new understanding of the value of agricultural sciences, said the 2009 winner of the World Food Prize for major contributions to research leading to the production of sorghum.

While technical assistance is helpful for developing counties, Ejeta said, it is just as important to develop a "can do" spirit in local, country-led research programs. "What is needed, in my view, is a wake up call" for local policy-makers, he said, so they begin to believe in the power of science and technology and make commitments to invest in research. Many leaders in developing countries don't yet recognize the returns that can result from such investment.

Like Beachy, Ejeta called for purpose-driven research pursued by public-private partnerships that tackle some of the growing challenges being faced by agriculture: climate change, water scarcity, energy efficiency. And he reminded the audience that despite the benefits of agricultural science, too much of the world still goes hungry.

"With all the breakthroughs that we have made in science around the world, we have not been able to give humanity that fundamental right, that God-given right to enough food," Ejeta said. But he remains optimistic that "our collective vision, our creativity and our sciences can... address issues of agriculture and natural resource management at home and abroad in a more holistic way than ever before."

"Agricultural Research: Changing of the Guard, Guarding the Change"

Roger N. Beachy
Director, National Institute of Food and Agriculture

Thank you for that kind introduction, and to the Committee for selecting me to deliver this inaugural lecture celebrating Charles Valentine Riley, a preeminent entomologist who worked to benefit agriculture as a scientist with the U.S. Department of Agriculture. I am honored to be in this role this evening.

Mr. Riley, who emigrated to the U.S. in 1860, worked as a farm laborer, writer and artist. He was named in 1868 as Missouri's first State Entomologist and advanced to be Chief of the U.S. Entomological Commission in 1878. His work led to the first successful use of biological control, control of scale insects in citrus in California. He had similar success in reducing insect damage to the French wine industry. Mr. Riley also played a significant role in establishing a National Office of Experiment Stations, the precursor to today's Agricultural Research Service, and other important changes in the USDA. He was a renaissance man in many different ways.

I think it extremely fitting that this inaugural lecture of the series takes place under the auspices of AAAS, the largest scientific organization in the United States and perhaps internationally. AAAS is devoted to many different topics and is a model for other science organizations around the globe. The imprimatur of AAAS for the Riley Lecture, with the society's historical twin focus on urging support for research and encouraging science-based policy decisions, lends credibility and urgency to the themes I want to address this afternoon: the transformative change which is underway in agricultural science, and how that change can and must inform the discovery and implementation of solutions to the most vexing of human problems.

That we are at a watershed moment in agriculture is likely taken as a given by many in this audience; but perhaps not by those who are less familiar with the critical role that agriculture plays in global issues. We have a disturbing tendency in American society – indeed, in the developed world – to equate truisms for truth. Consider, for example, what I often refer to as the "arrogance of plenty": the average Westerner gives little or no thought to whether there will be food tomorrow in the supermarket, that there will be fuel to power our cars and to heat and cool our homes, that there will be fiber for our clothes, paper for our books and printers, and timber to build our houses. It has been decades since these were top-of-mind concerns for most Americans – although we still have a big job to do to make sure that hunger is solved even in the United States.

The plenty that we enjoy, enabled by one of the highest standards of living in the world and subsidized by energy use per capita that far outstrips that of any other nation, has fostered – one might even say fore-ordained – a culture of neglect for agricultural science for more than 50 years. Because we do not feel the hunger that gnaws at nearly a billion of the world's citizens, and because the few American farmers that feed America and much of the world are often out of sight and mind of urbanites, we have become complacent in the support and advocacy for agricultural science. Perhaps even more concerning is that agriculture has become the whipping boy for those who look at the landscape of our great country.

It was not always thus, of course. With the nation at war with itself, the need to boost the economy to ensure sufficient funds to conduct the war, and the future of the nation anything but certain, President Lincoln turned to investments in science and research to secure the future. During his presidency he created what we today know as the U.S. Department of Agriculture and founded the land-grant universities to teach agriculture and engineering. These investments, coupled with other far-sighted acts of Congress and presidents through the years, created the most productive agricultural system this earth has ever known. These investments continue to pay incredible dividends in production agriculture, rural and urban wealth, food security, and protection and stewardship of our natural resources.

But I am here this afternoon to tell you that we are most assuredly living on the fruits of past investments while our current opportunities and future wealth and health of rural communities could well wither under the summer sun of complacency.

When President Lincoln created what would become USDA, he was fond of referring to it as "the People's Department" – a fact, not just a jingle – in that more than half of Americans in his day derived their livelihoods proximally from agricultural work; livelihoods came largely from their labors on the farm. This is the philosophy that underpinned research investments in agriculture for the following 75 years. In the years just prior to World War II, fully 40 percent of the nation's civilian R&D investments went to agriculture.

Fast forward another 75 years. The agency that I am proud to lead, the National Institute of Food and Agriculture, or NIFA, is the federal government's principal funder of agricultural research conducted at our public institutions, just as the NIH is the nation's principal funder and supporter of biomedical research at these same institutions. In the budget proposed for 2011, the entire NIFA budget is just about the size of the requested 2011 in-

crease of the NIH budget – and all we do is feed the world. Something seems wrong with our spending priorities.

With a few bright blips, federal funding for agricultural research has been stagnant or declining for decades. We are incredibly fortunate to have a robust private sector that is committed to support of research in corporate and public laboratories around the world, and from commodity check-off programs that support research in universities and institutes. The beef industry spends about 15% of its check-off programs, or $6 million on research; the cotton industry spends about $11 million of their $80 million check-off receipts on research; the soybean check-off fund spends about 10% of $74 million collected on research. And so on. More than $645 million is collected from producers of blueberries, milk, lamb, potatoes, mangoes, eggs, honey, beef, pork, and other food commodities. The great majority of check-off funds goes not to support research but for support of marketing and other priorities. Much of the research sponsored by the private sector is focused on relatively short-term, high impact outcomes that will support product lines and bring benefit to the bottom line in relatively short order. This seems to me a mistake at a time when funds are badly needed to advance the fundamental understanding of the organisms on which the science of agriculture and sustainability are based.

It falls, then, to federal funding to secure both the future of the long-term research, without which we cannot make the discoveries that have given us our productive and rewarding agricultural economy, and the translation of new knowledge to ensure that discoveries successfully enter the marketplace and provide food security for ourselves and our neighbors. All the while creating sustainable wealth for the rural communities that will provide the food, feed, and fiber to provide food and energy security.

Yet, the current level of funding to NIFA is far too small to accomplish all that is required of it. I recognize that this is not a good time to be calling for massive new federal investments in agricultural research. Nevertheless, that is what is needed. We need those investments, and I know that this President and this Secretary of Agriculture believe passionately in agricultural research as a wellspring of future prosperity and job creation, in particular in rural America. We must and we will advocate for strong funding – those of you who know me know that there is no more impassioned advocate to the White House and to Congress. Some of you are aware that I left a role as research scientist and Director of the Danforth Plant Science Center in a great hometown city, St. Louis, working with world-class colleagues who every day were making inroads in solving world hunger. I do not intend to preside over a flat budget at NIFA and a research paradigm more fitted for the 19th century than the 21st. But even I know I must temper that advocacy with a healthy dose of reality.

We must help citizens and decision-makers value and return to investment in agricultural research. Concurrently we need to realize the promise of agricultural research to solve the most intransigent problems we face: global food security, even in the face of severe disruptions in climate and weather while mitigating the emissions of greenhouse gases from agriculture; rising childhood obesity; energy security; and food safety among them.

We need to do the research we do better. And we need to make sure the results of that research are known by the policymakers and decision leaders who are charged with formulating sound national policy and making budget decisions. We need transformative change in the funding and translation of agricultural research into outcomes, solving real problems of real people. And we must measure whether or not we have been successful in doing so, and adjusting our course along the way to be more effective. There is transformative change in science all around us: it remains to us to embrace it, to harness it for agricultural research, and make sure we aren't changing just for the sake of change.

Last year, the National Academies released its analysis of the research that has been conducted in the life sciences during the past several decades and to project how it will be conducted in the decades to come. For those of you who don't know the report, *A New Biology for the 21st Century,* I highly recommend it, as it is a blueprint for revitalizing agriculture research. The report makes a very compelling case that we are at the cusp of a truly transformative epoch in science and science education. It is a time in which we can make incredible gains by breaking down the silos that separate physics and chemistry and biology and biomedical sciences and earth sciences and the social sciences, and adopt a unified approach to address bold, big questions. In tone and in detail it is a model for how agricultural science can and must be done in the new scientific landscape (and I quote):

> *"The lessons of history led the Committee . . . [on a New Biology for the 21st Century to recommend] . . . . that a New Biology Initiative be put in place and charged with finding solutions to major societal needs: sustainable food production, protection of the environment, renewable energy, and improvement in human health. These challenges represent both the mechanism for accelerating the emergence of a New Biology and its first fruits."*

Among the changes the Committee foresees and urges are an erosion of the traditional academic silos that have hamstrung truly synergistic approaches to science of the past in favor of a more system-wide approach to solve the big problems. In place of the ubiquitous single-investigator model, *A New Biology* anticipates an increasingly team-oriented approach, where researchers from disciplines as diverse as engineering, biochemistry, food processing, crop and animal science, genetics and physics – teams from departments scattered across campuses, between campuses, and between public and private sector institutions – collaborate to solve large-scale scientific problems.

An example of one such big problem: To understand the puzzle about why the nutritional status of some individuals is healthier than those of other individuals. The answer to the puzzle will likely come by knowing more about the genetics of the individual, the diversity of microbes in our intestinal tract, and how our diet affects the metabolism of the microbes to release nutrients that we absorb. This question links the sciences of human genomics, nutrition, microbial genomics and population biology, plant genetics and biochemistry, and agriculture itself. This knowledge may reduce obesity and improve nutrition while leading seed and food companies, and perhaps plant genetic engineers, to develop crops and foods that will be optimally matched for individual health and well-being.

A similar question could be asked about how to reduce the emissions of greenhouse gases in production of paddy rice. Solving problems such as this will require the intellect of scientists of many disciplines; implementing the outcomes will require still other disciplines. Clearly, it will not be business as usual at USDA if we adhere to the conviction that we can and must solve grand societal challenges.

The solutions to the societal challenges require changes of scientists: changes in the breadth of understanding of their world and beyond the specialties of their science. These changes include considering how their work impacts agriculture, environment, health, bioenergy, mitigation or adaptation to climate change, and to the social sciences, including economics, rural and urban social issues, law, business management, to name a few. A daunting challenge for an experienced scientist, and likely impossible for the aspiring young scientist.

Under this mandate it will not be business as usual on the nation's college campuses either, where so much of the nation's research that relates to food and agriculture is performed. One of the most disheartening things that I experienced as a graduate student, post-doctoral scientist, and as a career scientist visiting our colleges and universities, is the great divide – financially, academically, and managerially – between the programs where the next generation of agricultural science is taught and where research is performed. The teaching and training of the very same core sciences given in physics, microbiology, biomedical sciences biochemistry, and other programs are often different in different colleges. In some cases the traditional College of Agriculture might as well be a continent removed from the College of Life Sciences or the College of Arts and Sciences for all the cross-pollination and research partnering that occurs. This is not fair to the students, to our field, or to the taxpayers who support our educational systems and expect a payoff in the future in terms of knowledge and service.

The traditional notion of academic success, too, must be reexamined in the context of this new landscape. Tenure decisions that reward single-investigator grant winners over equally productive members of interdisciplinary and multi-institution teams can no longer be the gold standard. Faculty and departments that only perform research – and ignore the vital contributions of extension and education, and other types of translational research – will not thrive in an environment that values multidisciplinary and goal-oriented research. Universities should begin to see success of faculty and students as team participants, and reward faculty for their interactions rather than for their independence, on the practical outcomes of their work, and on the preparedness of their students for addressing the challenges of society.

A second agent that is forcing change is the emerging crisis in feeding the world's growing population. The FAO warns that the combined effect of population growth, strong income growth, and urbanization will require a doubling of food production by 2050. This doubling will need to occur despite changes in weather patterns, critical water shortages, increased soil salinity, and the necessity to reduce the energy and environmental footprints of agricultural practices. And this is not just a problem in "those other countries" that we often talk about: American farmers and foresters are already seeing downward pressure on some production systems, and many areas of the United States are as vulnerable to climate disruption as anywhere on earth. Thus far, we have maintained yields of our crops and food animals – but the pressure is increasing.

And because agriculture contributes significantly to greenhouse gas emissions we must reduce emissions from our agriculture, and encourage others to do the same.

Given the enormity of this crisis, we simply cannot afford to ignore any of the tools at our disposal to create the crops and livestock and production practices that will feed our future. We have made huge strides in crop and animal productivity in the US through conventional breeding, and we have robust and powerful breeding programs at USDA and in industry that we must and will support. However, conventional breeding alone will be insufficient to meet this growing need while meeting other societal goals of energy reduction, environmental protection, and a safe food supply. The long cycles needed to successfully breed traditional crop and livestock lines will always keep us behind the eight ball with a rapidly growing population increasingly partial to animal products for food.

Biotechnology gives us a fighting chance to create a world where world hunger needs are met while preserving or even restoring our natural resource base. It can supplement conventional breeding to provide the necessary rapid responses to emerging plant and animal diseases, to the severe climatic disruptions that are anticipated, and to more productive and sustainable agricultural systems. Consider the increased pressure from insect pests and pathogens that will attack crops globally, and the anticipated reduced fecundity of food animals, including in the US, as growing conditions are increasingly too hot, too dry, or too wet. Pathogens previously seen only in the tropics will attack US crops and new diseases will come to

our farm animals. Biotechnology will give us the capacity to respond to challenges in a timely manner; it can give agriculture the potential to stave off rapid onset of diseases and pests. Many scientists think it better to use genetic solutions, including biotechnology, to address these issues rather than to rely more heavily on chemical solutions.

The last agent of change I want to talk about – there are many more, but I don't want to stand between you and our distinguished panel! – is the growing awareness of food and agriculture in the minds of the American people. We are becoming a "foodie nation" in many ways: the desire for more locally produced foods, and for food that is more nutritious, is evident in many segments of society. The need to reduce childhood obesity is on the minds of many, from the White House to the mothers in the inner city, and all parts of society in between. There is also deep concern about the safety of fresh produce and meats. There is increasing concern about the conditions under which our food is produced and processed, and on the impact agriculture has on the environment. Agriculture hasn't had this kind of top-of-mind relevance for decades.

Many of these discussions focus on an unfortunately vague term: sustainability. This fact is unfortunate, because discussions around sustainability often become emotionally charged and discussants are left with a sour taste. The word sustainability is vague in meaning because by its very nature the concept has multiple dimensions – economic, environmental, and social. And all of these dimensions must be addressed simultaneously if we are to truly develop sustainable agriculture that will produce more of our fuel as well as our food than it does today, yet leave the environment and the consumer in a better place tomorrow than today. The change we need to embrace here is a commitment to a common understanding of sustainability and using scientific methods to define its reality. An agricultural system is not sustainable, no matter how lucrative it is or how productive it is, if it permits persistent food deserts to exists, or if the cost to transport or process the food adds more than marginal cost to the produce or substantially increases the total greenhouse gas emissions (farm to fork) than is afforded by other methods. An agricultural system is not sustainable if it destroys the environment in which it is located, or has environmental consequences as dire as the food insecurity it is designed to address. Production practices that do not help create rural wealth and allow farmers to stay on the land are not sustainable. Economic practices that do not preserve clean water, reduce greenhouse gas emissions, and maintain natural biodiversity are not sustainable. Social practices that cede agriculture production only to a few agribusinesses are not sustainable.

These are just a few of the grand challenges and the agents of change that are completely and utterly reshaping agriculture. We – in NIFA, in the ARS, and other parts of USDA, at the nation's college and universities, and on our farms and forests – need a new research paradigm matched to those changes. The most visible sign of the transformative change that we have set in motion is the National Institute of Food and Agriculture that we launched in early October. NIFA includes the competitive grants program, AFRI, and awards the formula or capacity funds that many of your universities apply to great effect. AFRI is the flagship research program for competitive grants in USDA, and most of the growth in research support in coming years will reflect our desire to work at meaningful scale on a discrete set of overarching scientific issues, each of which is selected because it has great potential to improve the lives of our citizens. And like its predecessor agency, CSREES, NIFA will ensure that the research we support finds its way into the hands of farmers and foresters, consumers, and others through the unique education and extension system that we help to support. In 2010 we began doing this by requiring meaningful linkages between research and extension and/or education in more of our research portfolio.

While other agencies and research performers struggle to effect the translation of bench science to applied science, USDA has for nearly 100 years had a built-in translation capacity unmatched by any other research entity – the Extension Service. We fully intend to support and grow that capacity through NIFA competitive grants. More of our awards will have requirements for education and/or outreach through extension than in the past. Similarly, our land grant colleges and universities will see growing opportunities as the competitive grants programs of NIFA expand. They will be part of the change – seeing greater growth through competition rather than entitlement alone. Our grants will require creating opportunities to recruit more students to the excitement of research in agriculture. We have established a program for NIFA Pre-doctoral and Post-doctoral Scientists [NIFA Scholars program announced June 21] to develop the next generation of scientists, many of whom will be trained in a multidisciplinary manner.

We will look to grow our engagement, in new ways, with colleagues at the 1890's land grant colleges and universities and in the tribal colleges. We must reach into the Hispanic and African American communities for talent for the workforce that will become the future of USDA. Researchers who want to work with us should prepare themselves to focus in the areas that represent designated targets for our programs: food production and sustainability; biofuels, climate change, and environment; food safety and nutrition, and global food security. There will always be grants for single investigators and small teams of scientists. However, there will be an increasing expectation that cross-disciplinary teams, cross-institutional, and regional teams be established to address the grand challenges that were discussed earlier.

NIFA is still a very small agency by any measure. We will therefore continue to seek partnerships from other federal agencies, including the National Science Foundation, US-

AID and the State Department, the Department of Energy, the Department of Defense, NIH, and others as opportunities arise and synergies are identified. We must also find ways to reduce the duplication of efforts between USDA-funded research and the research conducted in advanced laboratories in the private sector as we don't have enough money for this luxury.

When it exists, we will seek to reduce that duplication.

We need to find ways to address more of the research questions that are raised by producers of fresh fruits and vegetables, those that care for the crop pollinators, those that produce organic meats and vegetables, and those who work on small and local farms that serve rural and urban consumers.

We will do so.

We need to find ways to make more locally produced food available to our school children and learn more about how to make fresh goods more appealing by learning more about how children and young adults make their food choices.

We do not have the luxury of funding the many research interests of the scientific community or the food producers that need our input. We probably cannot continue to support the many research programs as separate but equal independent activities within a federal bureaucracy. NIFA and ARS are small agencies with very limited resources. Our competitive programs at NIFA and the intramural research capabilities at the Agricultural Research Service need to be more effectively aligned and harnessed to focus on common goals, even if there are advantages of approaching them differently.

We're just not going to be able to sustain what I call the peanut butter (or perhaps more appropriately, sunbutter!) on crackers approach – we have gotten in the habit of using a small jar of peanut butter to try to cover every conceivable cracker that comes our way. And you know, we were able to do that for a time but it wasn't the best way to do it, nor did it deliver the best research for the money of the American taxpayer.

Today, in this budget and social climate, we have far too many crackers and too little peanut butter. And when we decide how much peanut butter on a cracker is optimum – feeds the most people the most nutritious meal for the lowest cost – we always have folks who are second guessing us, insisting that their crackers are better and need more peanut butter, or that their crackers always had peanut butter covering all of the cracker surface a foot deep and that's what they need to go forward, or that it's somehow better to have a micron's worth of peanut butter on a cracker with their name on it than a shared cracker with a healthy amount of it on top.

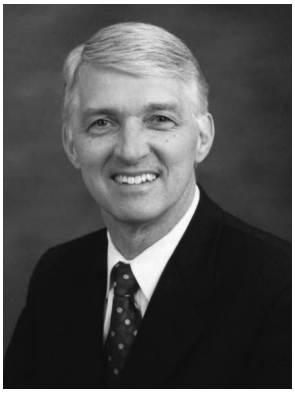
To be more direct, earmarking of small amounts of funds for specific researchers or universities to address specific local problems, does not serve the larger US research enterprise to solving the challenges that face our great nation or the world. This is particularly true for small research agencies such as NIFA and the ARS. We have to move away from agricultural research as an entitlement program and toward the management of a coordinated science portfolio aimed specifically at target problems. While agriculture per se is place-based, the solutions to agricultural problems are based in knowledge that is not place-based.

At the same time, I am deeply cognizant of the awesome responsibility USDA has to ensure the capacity of our colleges and universities to continue to do meaningful and productive research; with state budgets in freefall, now is not the time to pull back our support. I am committed to restoring USDA's historical role in building research and production capacity in the developing world. We won't be able to meet the food needs of the future with American produce alone, and the enormity of the need will ensure that American farmers always have ready markets for their crops and livestock. More countries around the world must be empowered, through knowledge and through enterprise, to be their own producers rather than relying on our surpluses.

Charles Valentine Riley lived and worked through one of the last great transformations in agriculture – the middle and late 1800s. Yet by all accounts this vibrant and exciting era of agricultural and entomological discovery did not turn Riley into a narrowly focused specialist bent on pursuing a single strand of this emerging scientific landscape. Rather, he is remembered today as a truly a "whole-picture" person – an artist, a poet, a writer, a journalist, a linguist, a naturalist, and a philosopher as well as a scientist.

We would do well to honor his memory this afternoon by finding the common ground we need to make sure our epoch of transformative change will be remembered a hundred years from now for its expansiveness, its vision, its willingness to take risks, and its commitment to solving the biggest problems we can. I am excited, and humbled, by the magnitude, the audacity, of this challenge – and I will be grateful for your wisdom and guidance as we meet it together as guardians of the change that will re-make the field of agricultural research.

Participant Bios



Roger N. Beachy
Director, National Institute of Food and Agriculture, USDA

Dr. Roger Beachy was appointed to be the first director of the National Institute of Food and Agriculture (NIFA) in October 2009, and in January 2010 was appointed Chief Scientist of USDA. NIFA is responsible for awarding extramural funds for Research, Extension and Education for the U.S. Department of Agriculture. Prior to this appointment, he served as the founding president of the not-for-profit Donald Danforth Plant Science Center in St. Louis, Missouri. In this role, Dr. Beachy was responsible for developing and implementing the Danforth Center's strategic direction, recruiting its staff, and formulating its research programs. Dr. Beachy, internationally known for his groundbreaking research on developing virus-resistant plants through biotechnology.

From 1991 to 1998, Dr. Beachy headed the Division of Plant Biology at The Scripps Research Institute, a leading biomedical research center in La Jolla, California. He was also Professor and Scripps Family Chair in Cell Biology and co-director of the International Laboratory for Tropical Agricultural Biotechnology (ILTAB) at Scripps.

Dr. Beachy was a member of the Biology Department at Washington University in St. Louis from 1978 to 1991, where he was Professor and Director of the Center for Plant Science and Biotechnology. His work at Washington University, in collaboration with Monsanto Company, led to the development of the world's first genetically modified food crop, a variety of tomato that was modified for resistance to virus disease. His technique to produce virus resistance in tomatoes has been replicated by researchers around the world and his groundbreaking work has led to the production of many types of virus-resistant plants. Research under Dr. Beachy's direction has led to a number of issued patents and pending applications. He has edited or contributed to 50 book articles, and his work has produced more than 230 journal publications.

Dr. Beachy has received a number of honors for his research. He is a member of the U.S. National Academy of Sciences and in 2001 received the Wolf Prize in Agriculture. He is a fellow in the American Association for the Advancement of Science, the American Academy of Microbiology, the National Academy of Science, India, and the Academy of Science of St. Louis. He was elected Foreign Associate of the Third World Academy of Sciences. He was the 1991 recipient of the Bank of Delaware's Commonwealth Award for Science and Industry and the 1990 recipient of the American Phytopathological Society's Ruth Allen Award. Dr. Beachy was awarded the Dennis Robert Hoagland Award from the American Society of Plant Biologists, an honorary Doctor of Science degree from Michigan State University, and the William D. Phillips Technology Advancement Award from the St. Louis County Economic Council. Dr. Beachy was named R&D Magazine's Scientist of the Year for 1999. In 2003, he was elected Councilor for the National Academy of Sciences, and currently serves as a member of the editorial board of the Proceedings of the National Academy of Sciences.

Dr. Beachy has served on numerous boards and committees, including the board of the International Crops Research Institute for the Semi-Arid Tropics in Hyderabad, India, and the board of the NIDUS Center for Scientific Enterprise, and other voluntary boards in the St. Louis region. He is a member of a number of scientific societies, including the American Society of Plant Biologists, American Phytopathological Society, American Society for Biochemistry and Molecular Biology, and American Society for Virology. He currently serves as President of the International Association for Plant Biotechnology. He has served as consultant in plant biotechnology for several companies and frequently lectures on the applications of biotechnology in agriculture, nutrition, and human health.

Dr. Beachy holds a Ph.D. in plant pathology from Michigan State University and earned a B.A. in biology from Goshen College in Goshen, Indiana.

Molly Jahn
Dean, College of Agricultural and Life Sciences, University of Wisconsin-Madison

Molly Jahn recently returned to her post as Dean of the College of Agricultural and Life Sciences at the University of Wisconsin-Madison after taking a leave of absence to serve as Deputy Under Secretary for Research, Education and Economics at USDA in November 2009. Jahn was appointed Dean in 2006 after establishing a highly recognized research career as a plant

breeder and geneticist at Cornell University. During Jahn's tenure at UW-Madison, extramural funding in the College nearly doubled and funding for several major facilities was secured including the Wisconsin Energy Institute for sustainable and renewable energy research.

Dr. Jahn's research has focused on the genetics, genomics, and breeding of crop plants, releasing more than two dozen varieties currently grown commercially on six continents including an All America Selection Gold Medal winner. She has also worked extensively in Africa, Asia and Latin America to link crop breeding objectives to improvement in human nutrition and income, and has had leadership roles in major international agricultural projects. She holds faculty appointments in the Departments of Genetics and Agronomy. Dr. Jahn received her BA with Distinction from Swarthmore College, holds graduate degrees from Cornell and MIT, and was named a AAAS Fellow in 2006.

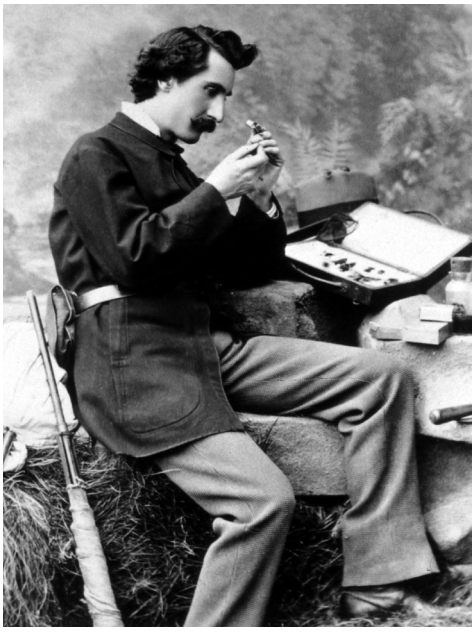
Neil Conklin
President, Farm Foundation

Neilson C. Conklin was named President of the Farm Foundation in January 2008. Dr. Conklin previously served as director of the market and trade economics division of USDA's Economic Research Service. In that role, he initiated the ERS research program on the economics of bioenergy, and directed development of new modeling frameworks on global trade policy analysis. Before joining ERS in 1999, Dr. Conklin spent six years at the Farm Credit Council as vice president and chief economist. He previously worked at the Office of Management and Budget, and has had teaching assignments at Arizona State University, the University of Arizona and at Colorado State University.

Gebisa Ejeta
Distinguished Professor of Agronomy, Purdue University

Gebisa Ejeta, a native of Ethiopia, received his early education including a BSc in Plant Science from Alemaya College of Agriculture. He completed graduate education in Plant Breeding and Genetics (MS, 1976; PhD, 1978) at Purdue University. His career has been devoted to international agriculture with contributions in human capacity development, institution building, and advocacy for agricultural sciences in support of the cause of the poor in Africa. He has been a member of the faculty of Purdue University since 1984, where he currently holds a position of Distinguished Professor of Plant Breeding & Genetics and International Agriculture. Professor Ejeta is the 2009 World Food Prize Laureate for his work in the development of drought tolerant and parasitic weed resistant sorghums and for facilitating the deployment and adoption of these crop cultivars in a number of African countries. He has served on review panels and advisory boards of major agricultural research and development organizations including the consultative group for international agricultural research (CGIAR), the Rockefeller Foundation, the Food and Agricultural Organization (FAO) of the United Nations, and for a number of national and regional organizations in Africa. He is a founding member of the Alliance for Green Revolution in Africa, a joint venture of the Rockefeller and Gates Foundation. Currently Dr. Ejeta serves as Senior Advisor to the USAID Administrator and as member of the Consortium Board of the CGIAR as well as Sasakawa Africa.

About Charles Valentine Riley (1843-1895)



"Professor Riley," as he was generally known, was born in Chelsea, London, England, on September 19, 1843. He attended boarding school at Dieppe, France and Bonn, Germany. Passionately fond of natural history, drawing, and painting, he collected and studied insects and sketched them in pencil and in color. At both Dieppe and Bonn, he won prizes in drawing and was encouraged to pursue art as a career.

At the age of 17, he came to the United States and settled on an Illinois farm about 50 miles from Chicago. Soon his attention was drawn to insect injuries of crops, and he sent accounts of his observations to the *Prairie Farmer.* At the age of 21, Riley moved to Chicago and worked for this leading agricultural journal as a reporter, artist, and editor of its entomological department. His writings attracted the attention of Benjamin D. Walsh, the Illinois State entomologist. It was through Walsh's influence as well as the recommendation of N .J. Coleman of *Coleman's Rural World* that Riley was appointed in the spring of 1868 to the newly created office of entomologist of the State of Missouri. From 1868 to 1877, in collaboration with T. W. Harris, B. D. Walsh, and Asa Fitch, Riley published nine annual reports as State Entomologist of Missouri, which unequivocally established his reputation as an eminent entomologist. Today, authorities agree that these nine reports constitute the foundation of modern entomology.

From 1873 to 1877, many Western States and territories were invaded by grasshoppers from the Northwest. In some states their destruction of crops was so serious that it caused starvation among pioneer families. Riley studied this plague and published results in his last three Missouri annual reports and worked to bring it to the attention of Congress. In March 1877, he succeeded in securing passage of a bill creating the United States Entomological Commission, the Grasshopper Commission administered under the Director of the Geological Survey of the U. S. Department of the Interior. Riley was appointed chairman, A. S. Packard, Jr., secretary, and Cyrus Thomas, treasurer.

All this time, Riley, with the help of Otto Lugger, Theodore Pergrande, and others, was also making brilliant contributions to the knowledge of the biology of insects. Besides studying the life cycles of the 13 and 17 year cicadas, he also studied the remarkable Yucca moth and its pollination of the Yucca flower, a matter of special evolutionary interest to Charles Darwin. In addition, he conducted intensive life history studies of blister beetles and their unusual triungulin larvae, and the caprification of the fig.

In the spring of 1878, Townend Glover retired as entomologist to the U. S. Department of Agriculture and Riley was appointed his successor. After a year in this position, Riley resigned owing to a disagreement with the Commissioner of Agriculture over Riley's practice of making independent political contacts; he then continued the work of the U. S. Entomological Commission with others, from his home. Two years later, after the inauguration of President James A. Garfield in 1881, Riley was reappointed and remained chief of the Federal Entomological Service until June 1894, when the Service was renamed the Division of Entomology of the U.S. Department of Agriculture. In 1882, Riley gave part of his insect collection to the U. S. National Museum, now The Smithsonian Institution, at which time he was made honorary curator of insects. In 1885, he was appointed assistant curator of the Museum, thus becoming the Museum's first curator of insects, whereupon he gave the Museum his entire insect collection consisting of 115,000 mounted specimens (representing 20,000 species), 2,800 vials, and 3,000 slides of specimens mounted in Canadian balsam.

One of Riley's greatest triumphs while Chief of the Federal Entomological Service was his initiation of efforts to collect parasites and predators of the cottony cushion scale, which was destroying the citrus industry in California. In 1888, he sent Albert Koebele to Australia to collect natural enemies of the scale. A beetle, *Vedalia cardinalis,* now *Rodolia cardinalis,* was introduced into California and significantly reduced populations of the cottony cushion scale. This effort gave great impetus to the study of biological control for the reduction of injurious pests and established Charles Valentine Riley as the "Father of

the Biological Control." For a review of the cottony cushion scale project, see Doutt, 1958.

A prolific writer and artist, Riley authored over 2,400 publications. He also published two journals, the *American Entomologist* (1868-80) and *Insect Life* (1889-94). Riley received many honors during his lifetime. He was decorated by the French Government for his work on the grapevine *Phylloxera*. He received honorary degrees from Kansas State University and the University of Missouri. He was an honorary member of the Entomological Society of London and founder and first president of the Entomological Society of Washington. He and Dr. L. O. Howard, Riley's assistant in the Federal Entomological Service, were among the founders of the American Association of Economic Entomologists, which became part of Entomological Society of America in 1953.

Tragically, on September 14, 1895 Riley's life was cut short by a fatal bicycle accident. As he was riding rapidly down a hill, the bicycle wheel struck a granite paving block dropped by a wagon. He catapulted to the pavement and fractured his skull. He was carried home on a wagon and never regained consciousness. He died at his home the same day at the age of 52, leaving his wife with six children.

About the Organizations

In 2008, the Charles Valentine Riley Memorial Foundation (RMF) selected the American Association for the Advancement of Science (AAAS) to receive an endowment to establish an annual lecture *"to promote a broader and more complete understanding of agriculture as the most basic human endeavor and … to enhance agriculture through increased scientific knowledge."*

Concurrently with establishment of the endowment, a collaborative agreement between RMF, AAAS, and the World Food Prize Foundation (WFPF) was signed to implement the annual lecture. Collaboration between AAAS, RMF, and WFPF provides a unique opportunity to build upon Charles Valentine Riley's legacy as a "whole picture" person with a vision for enhancing agriculture through scientific knowledge. Professor Riley's involvement with AAAS, beginning as a member in 1868, being elected a Fellow in 1874, and serving as Vice President for the biology section in 1888, brings into the perspective his broad view of how science impacts on agriculture when placed in the broadest contest.

AAAS

The American Association for the Advancement of Science (AAAS) is the world's largest general scientific society and publisher of the journal *Science* (www.sciencemag.org), *Science Signaling* (www.sciencesignaling.org), and *Science Translational Medicine* (www.sciencetranslationalmedicine.org). AAAS was founded in 1848, and serves 262 affiliated societies and academies of science, reaching 10 million individuals. *Science* has the largest paid circulation of any peer-reviewed general science journal in the world, with an estimated total readership of 1 million. The non-profit AAAS (www.aaas.org) is open to all and fulfills its mission to "advance science and serve society" through initiatives in science policy, international programs, science education, and more. For the latest research news, log onto EurekAlert!, www.eurekalert.org, the premier science-news Web site, a service of AAAS.

Charles Valentine Riley Memorial Foundation

The Charles Valentine Riley Memorial Foundation (RMF) is committed to promote a broader and more complete understanding of agriculture and to build upon Charles Valentine Riley's legacy as a "whole picture" person with a vision for enhancing agriculture through scientific knowledge. RMF, founded in 1985, recognized that agriculture is the most basic human endeavor and that a vibrant, robust, food, agricultural, forestry, and environmental-resource system is essential for human progress and world peace. RMF conducts a wide range of program activities that include discussion groups, forums, round tables, workshops, briefing papers, and lectures on various parts of the food, agricultural, forestry, and environmental-resource system. RMF's goal is to have all world citizens involved in creating a sustainable food and agriculture enterprise within a responsible rural landscape. For more information, visit http://www.rileymemorial.org.

World Food Prize Foundation

Founded by Nobel laureate and "Father of the Green Revolution" Dr. Norman E. Borlaug, the World Food Prize is a $250,000 award presented annually for breakthrough achievements in science, technology, and policy that have improved the quality, quantity, and availability of food in the world. Termed "the Nobel Prize for Food and Agriculture" by several heads of state, it is presented each October in conjunction with a week of events that includes the international "Borlaug Dialogue" symposium and gathers pre-eminent global leaders and experts representing over 65 countries. The 2010 World Food Prize events will take place October 13-15 in Des Moines. Information about the World Food Prize events, highlights from past Borlaug Dialogue symposia, and nomination criteria are available at www.worldfoodprize.org.

Proposed 2011 Federal Budget for Food, Nutrition, Agriculture, and Natural Resource Sciences

William Fisher
Institute of Food Technologists

Karl Glasener and Caron Gala Bijl
American Society of Agronomy
Crop Science Society of America
Soil Science Society of America

Mary Lee Watts
American Society for Nutrition

Lowell Randel
Federation of Animal Science Societies

Steve Bullard
National Association of University Forest Resource Programs

Jim Gulliford
Soil and Water Conservation Society

Highlights

– USDA proposed an increase in funding for NIFA's competitive Agriculture and Food Research Initiative from $262 million in FY 2010 to $429 million in FY 2011. Of the requested amount, AFRI is dedicating $20 million in FY 2011 towards Food Safety research funding and an additional $50 million is proposed for the Human Nutrition and Obesity section.

– NSF's Basic Research to Enable Agricultural Development (BREAD) Program received initial federal support of $6 million for basic research to test innovative hypotheses, approaches, and technologies for sustainable, science-based solutions to problems of agriculture in developing countries.

– The President's budget announced an additional $10 M for increased support to five USDA regional feedstock research and demonstration centers.

Introduction

Food, agricultural, nutrition, and natural resource sciences are poised to make major contributions to improve human health and protect our environment. With the launch of the National Institute of Food and Agriculture (NIFA) in 2009, Agriculture Secretary Tom Vilsack said "the opportunity to truly transform a field of science happens at best once a generation." With the release of a report by the United Nations Food and Agriculture Organization stating that food production will need to nearly double by 2050 to meet the demands of a world population totaling more than nine billion, this announcement is timely. The current administration has identified five "societal challenge" areas for emphasis including ending world hunger, improving nutrition and reducing child obesity, ensuring food safety for all Americans, securing America's energy future through renewable biofuels, and mitigating and adapting agriculture to climate change.

Food Safety

American consumers enjoy one of the safest food supplies in the world. However in order to keep pace with changes in the global food supply chain, production, and consumption we need to continue to build upon and improve our nation's food supply from both unintentional contamination (food safety) and deliberate attack (food defense).

The Obama Administration has made food safety reform a major domestic policy initiative. On March 14, 2009, President Obama announced the creation of the Food Safety Working Group, chaired by the Secretaries of the Department of Health and Human Services and the Department of Agriculture. This group was created to advise the Administration on how to upgrade the food safety system for the 21st century. The Working Group has recommended a new, public health-focused approach to food safety based on three core principles: prioritizing prevention; strengthening surveillance and enforcement; and improving response and recovery.

Federal R&D funding for food safety primarily resides within the USDA and HHS budgets. Within USDA, the largest portion of research funding is found within ARS and NIFA. While ARS is the USDA's in-house scientific research agency, NIFA is the USDA's major extramural research agency funding individuals, institutions, and public, private, and non-profit organizations.

The USDA has proposed an increase in funding for NIFA's competitive Agriculture and Food Research Initiative from $262 million in FY 2010 to $429 million in FY 2011. Of the requested amount, AFRI is dedicating $20 million in FY 2011 towards Food Safety research funding. The FY 2011 budget includes an increase of approximately $6 million to enhance research to safeguard the Nation's food supply through food safety research by the Agriculture Research Service (ARS).

HHS will invest approximately $1.4 billion to strengthen food safety efforts and implement the core principles of the President's Food Safety Working Group. The FDA requests $326.3 million for the Transforming Food Safety

Initiative, which reflects President Obama's vision of a new food safety system to protect the American public. The FDA will set standards for safety, expand laboratory capacity, pilot track and trace technology, strengthen its import safety program, improve data collection and risk analysis, and begin to establish an integrated national food safety system with strengthened inspection and response capacity.

Food Security

Global food security, access to affordable, safe, and nutritious food, is critical to overcoming poverty and achieving global stability. The United Nations Food and Agriculture Organization (FAO), USDA and United States Agency for International Development (USAID) have identified 'food security' as a key focus and challenge for global institutions in the coming years, especially in the face of a rapidly growing world population. In the next 40 years, it is estimated that the global population will increase by 2.4 billion to over 9 billion, requiring a doubling of production and better distribution systems for agricultural products.

FAO estimates that 70 percent of new agricultural production will come from adoption of new or existing technologies and 30 percent from new production on marginal land or from increased yields on land already in production. Today, scientists are working in interdisciplinary research teams to develop new production tools and sustainable production systems appropriate for farmers' needs, which require fewer inputs—energy, land, nutrients, and water.

Some of the food security programs at USAID include the Global Hunger and Food Security Initiative (Initiative), unveiled in 2009, which will commit $1 billion to the development of strategies to overcome hunger and mitigate food insecurity. One key element of the Initiative is a commitment to research that addresses agricultural technology needs. The Initiative renews investments in national and international research systems, including the Consultative Group on International Agricultural Research (CGIAR) in developing countries, as well as training of students in science and applications that will support ongoing R&D for the agricultural sector. Collaborative Research Support Programs (CRSP) support collaborative work between U.S. universities and international partners to address critical agriculture and food security issues. Together, the CGIAR and CRSP programs reflect a significant part of the government's approach to improving global food security. Through plant and animal breeding and germplasm collection and preservation, the CGIAR system helps find country-led solutions to food security challenges by harnessing science and technology to boost agricultural productivity.

In the National Institute of Food and Agriculture (NIFA) at the US Department of Agriculture (USDA), the International Science and Education Competitive Grants Program (ISE) supports research, extension, and teaching activities that will enhance the capabilities of American colleges and universities to conduct international collaborative research, extension and teaching. The principal USDA NIFA competitive grants program, Agriculture and Food Research Initiative (AFRI), supports increased food security through the expansion of R&D on plant and animal diseases that threaten public health and agricultural production. The President's FY 2011 budget proposes a significant increase in AFRI, of which $13 million would be for this purpose.

Finally, NSF's Basic Research to Enable Agricultural Development (BREAD) Program will receive initial support of at least $6 million in FY 2011 for basic research to test innovative hypotheses, approaches, and technologies for sustainable, science-based solutions to problems of agriculture in developing countries. BREAD is supported by both NSF and contributions from the Bill and Melinda Gates Foundation.

Nutrition & Obesity

Nutrition is essential to life, and in the past century our knowledge about how foods nourish our bodies and contribute to health has grown exponentially. Since the late 1800s, federal government support for nutrition research has led to breakthroughs in our understanding of food composition, human nutrition requirements, and dietary patterns. In essence, human nutrition research enables us to make the connection between what we grow, what we eat and our health–from prevention to chronic disease management at the primary, secondary and tertiary levels.

Overweight and obesity have taken center stage as the public health challenge. Nutrition research is indispensable to furthering our understanding of and ability to effectively address this epidemic. With approximately 65 percent of U.S. adults and 30 percent of children and adolescents classified as overweight or obese, preventable chronic diseases related to diet and physical activity cost our economy over $117 billion annually. This cost is predicted to rise to $1.7 trillion in the next 10 years.

Basic and applied research on human nutrition and nutrient composition, food processing and nutrition monitoring is essential to the economy. This research and data collection form the foundation on which federal nutrition policy is based and multi-billion dollar nutrition assistance programs are guided. Although the U.S. historically has had the world's most nutritious, most affordable and safest food supply, our population suffers from some of the highest rates of diabetes, heart disease, and obesity in the world. Awareness of this paradox and the impact on health care costs underscores the need for improved information on dietary intake and improved strategies for dietary change.

The National Institutes of Health (NIH) funds 90 percent of government-funded nutrition research, followed

by the USDA. Other departments that fund a limited amount of competitively-awarded nutrition projects are the Departments of Defense (DoD), Veterans Affairs, and the National Aeronautics and Space Administration. For example, the DoD has funded several extramural projects on breast cancer and nutrition. The FDA also currently funds research on consumer use of the food label. The National Center for Health Statistics at the Centers for Disease Control and Prevention, in partnership with USDA, is responsible for nutrition monitoring--- administering and compiling data from the USDA's What We Eat in America dietary survey that is part of the National Health and Nutrition Examination Survey (NHANES). It is the only nationally representative nutrition survey in the nation that provides foundational reference data for what the country is consuming.

Within the NIH, the largest contributors to nutrition research are the NIDDK, NCI and NHLBI. In FY 2009, 4,500 projects were funded on topics such as nutrigenomics, medical nutrition interventions, and behavioral and lifestyle influences on health. Nutrients and diet patterns as they relate to chronic diseases are the most commonly funded areas. NIH has made a significant investment in obesity-related research across multiple ICs.

At the USDA NIFA, the AFRI program historically supports projects in Human Nutrition and Obesity, Dietary Bioactive Components, and Food Quality and Value. In FY 2011, an additional $50 million is proposed for the Human Nutrition and Obesity section. The USDA ARS Human Nutrition program conducts essential data collection and food composition analysis. The program has shifted to allocate more resources to obesity, from 10 percent of funds in FY 2004 to almost 40 percent projected for FY 2011. The USDA ARS Human Nutrition Research Centers (HNRCs) are the major portion of the ARS nutrition program and provide critical infrastructure and capacity for nutrition research and the ability to conduct hypothesis-driven research. The centers leverage funds from multiple federal agencies and private sector sources, particularly the university-based centers, but also have the capacity to run large trials with multi-disciplinary teams.

Renewable Energy

The U.S. is producing 12 billion gallons per year of biofuels, mostly from corn grain ethanol. Expanding the biofuels industry to achieve the 36 billion gallons target by 2022 will require the development of an expanded agricultural and wood fiber commodity sector, and presents many opportunities and challenges. Rural land use is constantly changing, but there are limits to the extent to which existing land uses can change without disrupting existing food, feed, and fiber markets. One strategy for integrating biofuels feedstocks into existing agricultural production systems is to replace higher-risk, less productive crops or abandoned lands with lower-risk and more productive cellulosic feedstock crops. Also, more intensive, multiple-year management strategies could be used to get greater production from the same amount of land, and thus reduce pressure to expand production onto environmentally sensitive or marginally viable lands.

On May 5, 2009, a Presidential Directive called for accelerated investment in and production of biofuels. The President's Biofuels Interagency Working Group released its first report, Growing America's Fuels, which lays out a strategy to advance the development and commercialization of a sustainable biofuels industry. The plan identifies USDA as having responsibility for the development of improved non-food biomass crops and woody species varieties, and research into ways to sustainably produce biomass as a part of agricultural production and forest management. The plan also identifies DOE as having responsibility over discovery science inquiry that focuses on longer-term fundamental science breakthroughs for advanced biofuels and to determine suitable technologies for full-scale commercial deployment.

Even though ethanol from corn grain is an important renewable fuel source, and cellulosic ethanol will soon be contributing as well, there is need for research to speed the development of advanced biofuels. However, the markets for the feedstocks required to produce these fuels, and many of the promising process technologies that are needed to made advanced biofuels, have only been demonstrated at bench scale and are just beginning to be developed through the scale-up process. The USDA-Forest Service focuses its bioenergy research investment on the science and technology to sustainably produce, manage, harvest, and convert woody biomass to liquid fuels, chemicals, and other high-value products.

The President's budget announced an additional $10 M for increased support to five USDA-ARS regional feedstock research and demonstration centers. The purpose of the centers is to accelerate the scientific breakthroughs needed to ensure that adequate biomass supplies are available for the production of advanced biofuels and other bio-based products. These centers will develop regional strategies to help as many rural areas across the country as possible participate and benefit economically from expanded biofuel production, while protecting the natural resources base upon which we all depend for clear air, water, and other ecosystem services. The centers bring together the talents and expertise of leading government and university researchers, scientists in private industry, investors, and entrepreneurs.

At the Department of Energy, Bioenergy Research Centers (BRCs), part of the Office of Science, represent multidisciplinary, multi-institutional partnerships between universities, national laboratories, and the private sector created to accelerate the transformational breakthroughs in basic science needed for the development of cost-effective technologies to make production of cellulosic (plant-fiber based) biofuels commercially viable on a national scale. The Feedstock Infrastructure

(FI) Program in the Office of Energy Efficiency and Renewable Energy (EERE) develops technologies to provide reliable, cost-competitive, and environmentally sustainable biomass feedstock supplies. FI has three main areas of focus within the platform addressing this overarching strategic goal: feedstock production, feedstock logistics, and environmental sustainability.

Environmental Quality

The ability to identify management practices and decisions that improve water and air quality in agroecosystems is a key element of sustainable agricultural systems. Globally, agriculture faces the challenge of efficiently using land and water resources to produce food, fiber and biofuel feedstocks, while sustaining the land's productive capacity, and minimizing the impact of sediment, nutrient, pesticide, pathogen and pharmaceutical loss to the environment. Similarly, the world's need for fresh water continues to expand, increasing the importance of protecting water quality to ensure its continued use and reuse. Research and development can identify ways to improve the efficiency of existing agricultural production systems, identify and quantify health and environmental effects, and develop new information, technologies, and applications to protect and restore agricultural lands and the environment.

The USDA Mississippi River Basin Healthy Watersheds Initiative (MRBI), announced in November 2009, commits $320 million over four years to work with agricultural producers to address soil conservation and water quality protection needs in 42 watersheds of the Mississippi River Basin. This project supports basic and applied research in crop production, the development of practices and management strategies to reduce nutrient loss from agricultural lands, the understanding of nutrient fate and transport and the effect of nutrients on the formation, extent, severity, and duration of the Gulf's hypoxic zone. This initiative supports the implementation of the Gulf Hypoxia Action Plan 2008 as well as the regional priorities outlined in the Gulf of Mexico Alliance's Governor's Action Plan II, both of which describe strategies to reduce, mitigate, and control hypoxia in the Gulf and improve water quality in the Mississippi River Basin. The MRBI will involve close collaboration between the EPA, USDA, and the U.S. Geological Survey (USGS) efforts to measure progress in nutrient reduction within the Basin.

At the USDA ARS, the Obama Administration has proposed funding in the FY 2011 budget to establish long-term production and environmental management trials in watersheds to develop strategies to sustain agricultural productivity in the Mississippi River Basin, while reducing unwanted exports from agricultural lands and effectively managing water resources ($2.5 million). USDA ERS is implementing "N in Agricultural Systems: Implications for Environmental Policy", a research project to assess the status of U.S. agriculture in regards to nitrogen management, and the economic and environmental performance of policy approaches, including financial assistance, water quality trading, and GHG markets and regulation.

The Environmental Protection Agency, Water Quality Research Program (WQRP) is designed to support the Clean Water Act (CWA), providing scientific information and tools to the EPA to help protect and restore the designated uses of water bodies that sustain human health and aquatic life. The program conducts research on the development and application of water quality criteria, the implementation of effective watershed management, and the application of technological options to restore and protect water bodies using information on effective treatment and management alternatives.

Forest Service Research and Development (FS R&D), the world's largest forest research organization, provides scientific information and new technologies to support sustainable management of the Nation's forests and rangelands. Research is directed toward sustaining healthy watersheds, forest products, wildlife protection, outdoor recreation opportunities, and other benefits. The FY 2011 President's Budget proposes $304 million for Forest and Rangeland Research, a decrease of $8 million from FY 2010. The proposed budget is spread among Forest Inventory and Analysis (FIA; 20%) and the research areas of: Wildland Fire and Fuels (8%); Invasive Species (12%); Outdoor Recreation (2%); Resource Management and Use (33%); Water, Air, and Soil (11%); Wildlife and Fish (10%); and Inventory and Monitoring (4%). This program anticipates at least $30 million in grants and agreements to approximately 600 partners.

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