AGRICULTURAL BIOLOGICAL WEAPONS THREAT

FOOD SAFETY, SECURITY AND EMERGENCY PREPAREDNESS

KANSAS STATE UNIVERSITY

JON WEFALD, PRESIDENT

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TESTIMONY TO THE U.S. SENATE'S EMERGING THREATS SUBCOMMITTEE

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27 OCTOBER 1999

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With the end of the Cold War, the United States is the world's dominant military superpower. Although America may be compelled at times to engage in military actions around the world, there are few conventional military threats to our national security.

With the explosion of the Information Age, driven largely by the United States, the American economy has surged past our global competitors. The United States is the world's dominant economic superpower, and as a result, there are few conventional economic threats to our national security.

In these apparently secure times, it would be easy to become complacent.

But what about unconventional threats to our national security?

Biological weapons of mass destruction and means for mass disruption are available for rogue governments and extremist groups. Could they threaten our national security? Positively! You can bet your way of life on it.

The "homeland defense" initiative and related endeavors have been undertaken to protect our country from weapons of mass destruction or, perhaps more accurately, to provide a means for rapid response when such threats become a reality. As of early 1999, these efforts focused almost exclusively on preparing America's population centers for threats to human health – predominantly, those of chemical and biological origin.

However, the recent encephalitis outbreak in New York City caused by the West Nile virus illustrates just how far we have to go in recognizing and dealing with exotic biological threats. Fortunately, a veterinarian at the Bronx Zoo – a pathologist examining dead birds – was persistent in her efforts to convince federal public health officials that there might be a relationship to cases of encephalitis in the area.

Although it may seem strange to some that a veterinarian linked bird deaths to a human health problem, many of the world's most dangerous biological agents – anthrax, Ebola,

and the like – are known to be transmitted from animals to man. It was surprising, therefore, to read in the New York Times on 11 October 1999 that "no one had anticipated an outbreak in which crucial evidence would be uncovered by a wildlife specialist." This should be an integral part of the homeland defense surveillance program.

The importance of protecting our food crops, food animals, and domestic food supply is paramount. Agricultural production provides 22 million jobs in the U.S., even though less than 2 million are farmers and ranchers per se. The agribusiness sector contributes over $1 trillion annually to our economy, which amounts to 15% of the U.S. Gross Domestic Product.

What would happen to the American economy if a significant portion of our food supply was destroyed by plant or animal pathogens or was tainted (or even thought to be tainted) with toxins or human pathogens?

What would happen to food prices in the U.S. where less than 10 cents of every household dollar is spent on food? In some developed countries, spending for food can be two or three times that amount. In third-world countries, it can approach five times. Think about the impact on our economy if food prices doubled or tripled in a matter of weeks or months.

Our agricultural exports amount to approximately $60 billion annually. If the foreign wheat pathogen karnal bunt finds its way into U.S. wheat fields, our exports of wheat would be halted immediately. Karnal bunt is already as close as Mexico. Likewise, if our domestic livestock become afflicted with foot and mouth disease, American beef and pork exports would be embargoed at once. Foot and mouth disease is found in Cuba and many other countries around the world.

Karnal bunt and foot and mouth disease are but two of a multitude of naturally occurring biological threats to American agriculture. Almost any of these could show up in the U.S. quite by accident … or, perhaps, not by accident.

There are many reasons to believe that rogue governments and extremist groups might prefer to use agricultural biological weapons against the U.S. rather than targeting people in American cities. First, the technology involved is less sophisticated, and there is much less risk to the individuals collecting or developing the biological agents, i.e., it's easier and safer for the perpetrator. In military jargon, food crops and food animals in the U.S. represent "soft targets;" they're largely unprotected and vulnerable to attack. The likelihood of U.S. officials detecting the attack early on is also slight, thereby allowing plausible denial and reduced retaliatory risk. And, finally, there are fewer ethical quandaries for those who might hesitate to kill people randomly and indiscriminately. This could be especially true for some American radical groups.

There are also lessons from the past that argue for the use of biological weapons targeted to agriculture rather than people. Prior to the unilateral termination of the biological weapons program in the U.S. in 1969, experts in the program had surmised that food crops and food animals could be decimated with greater certainty than could human populations. A human epidemic/pandemic could not be assured with any of the biological agents available

at the time. And even the highly virulent and alarming Ebola outbreaks in Africa a couple decades ago burned themselves out almost as quickly as they appeared.

Targeting agricultural crops and animals is another matter. Brucellosis, hog cholera, Newcastle disease in poultry, wheat rust, and rice blast disease were all weaponized in the old BW program. Field tests suggested that these weapons might well induce large-scale epidemics. And while the U.S. stopped production of biological weapons in the 1960s, a number of other countries have continued researching and producing these weapons into the 1990s – Russia, China, North Korea, Iraq, Libia, Pakistan, and a dozen or so more. Many, if not all, of these countries have agricultural biological weapons in their arsenals. The advantage they perceive is clear: infectious biowarfare agents have the potential to proliferate broadly once they're released; the devastation from chemical weapons remains relatively contained.

Consider for a moment a scenario where only wheat and rice are targeted. Wheat and rice account for an astonishing 45% of the world's calories. A terrorist strike against the cereal crops would threaten the foundation of our food supply – the foundation of the world's food supply. A widespread disease outbreak affecting these crops could cause worldwide famine. A localized strike against these "soft" targets with a quarantine pathogen could cause an embargo of U.S. exports, threatening our balance of payments and causing regional economic collapse.

To make matters worse, a terrorist strike against our food crops could occur without requiring that the terrorists set foot on American soil. African ergot, a serious disease of sorghum, was introduced inadvertently into southern Brazil in 1996. By 1997, it had spread throughout Latin America and had arrived in the northern most sorghum producing areas of Nebraska.

That's not reassuring.

The concentrated, modern-day production practices for beef, swine, and poultry provide easy, "soft" targets of opportunity as well. The beef feedlot industry in the central plains already sustains huge financial losses annually from infectious diseases and foodborne pathogens. And livestock in the U.S. are no longer vaccinated against many of the infectious agents that were eradicated here decades ago, creating at-risk populations for many deadly and highly infectious diseases. How's that for an easy mark for terrorists? A vial containing pathogens for foot and mouth disease, bovine tuberculosis, cowpox, or something more exotic or genetically engineered could be devastating.

The vision of National Guard troops having to machine-gun tens of thousands of diseased cattle in Kansas' feedlots doesn't present a pretty picture.

Of course, human foodborne pathogens and toxins can't be ignored as terrorist threats either. Various mycotoxins occur naturally in moldy grains, cereals, and agricultural products. The insidious nature of these toxins rests in the fact that they are effective at extremely low dosages, they can accumulate significantly in feed grains in the absence of yield reduction in the field, and microorganisms can be genetically engineered to increase toxin production and potency. These toxins can cause a variety of human health problems,

including neurological disorders, liver failure, cancer, and death, and they would make ideal biological weapons targeted to agricultural products. The mycotoxin T2 has already been implicated in suspected biological attacks.

Then there's the more traditional foodborne pathogens that have caused significant health problems in the U.S. in recent years – *E. coli*, *Salmonella*, *Listeria*, *Cryptosporidium*, Hepatitis A, and many more. Corruption of the domestic food supply with such agents in the absence of bioterrorist activity is already a tremendous societal burden. And if unintentional contamination of our food supply is potentially devastating, the terrorist threat in the food arena is almost incalculable. What even more horrific biological agents might be introduced? The causal agent for Mad Cow Disease perhaps? There are plenty of pathogens out there to choose from, and the food processing industry is another one of those "soft" targets.

So, as we look to the new millenium, what's the greatest plausible threat to America's national security? The Y2K bug? Terrorist attacks on U.S. cities? No, it's more likely to be the use of agricultural biological weapons against our food supply. And America can't just go out on the world market and purchase food as a replacement for losses sustained in such an attack. We *are* the world food market.

Countering the agricultural biological weapons threat will take a coordinated effort involving federal, state, and local government entities, relevant industries, and America's research universities. By leveraging the unique strengths of each stakeholder, effective surveillance and response strategies can be developed for mitigating the threat. Moreover, R&D programs focused on the detection and prevention of emerging biological threats can evolve quite reasonably from existing programs addressing endemic threats to our food crops, food animals, and domestic food supply.

Of all the requirements for an effective civil defense, food safety and security program, providing adequate surveillance would seem the most difficult to implement with any degree of certainty. Ideally, there should be individuals trained in recognizing plant and animal diseases and foodborne pathogens stationed near every agricultural soft target coast to coast, so early diagnosis could be assured. It sounds impossible … and expensive. However, America's land-grant university system may offer the answer.

University scientists – extension specialists, plant pathologists, veterinarians, food safety experts – may very well be the first to encounter and diagnose an emerging agricultural biological threat, whether naturally occurring or terrorist introduced. In the land-grant system, relevant expertise is available county by county, state to state. Why not mobilize this system for surveillance, early detection, and rapid response?

University scientists are already developing new means for detecting and dealing with endemic threats to our food crops, food animals, and domestic food supply. They're addressing disease prevention by breeding and genetically engineering food crops for multi-agent resistance. They're providing surveillance and diagnosis for plant and animal pathogens and toxins, and they're developing innovative diagnostic tools. They're creating better vaccines for endemic diseases of food animals. They're developing improved methods for screening and decontaminating tainted food products.

As America's first land-grant university, Kansas State has a long history of dealing with endemic threats to our food supply. In fact, we've been working in all the areas mentioned above. And being situated in America's food producing heartland – Kansas being the number one producer of wheat, sorghum, and beef – we're likely to be at the epicenter of an agricultural biological weapons attack. As a result, we opted to mobilize.

As part of a statewide advanced technology initiative earlier this year, K-State identified agricultural biotechnology as a primary strategic thrust to drive the economic engine of Kansas; food safety and security is an integral part of this effort. We have over 130 faculty scientists working on topics of relevance. We have strong programs in developmental biology that underpin the agricultural biotechnology initiative. K-State faculty are studying the biochemistry and molecular biology of pathogenesis. If we are to develop broad-based protective measures against infectious agents, an understanding of virulence factors and how pathogenic mechanisms overcome resistance is essential. K-State also has unique strengths in insect molecular genetics, insects being the vectors for many dangerous pathogens.

K-State has established and garnered NSF support for the Great Plains Cereals Biotechnology Consortium with formal linkages to the University of Nebraska, Oklahoma State University, and the Noble Foundation. Major research efforts are ongoing to introduce broad-spectrum disease resistance in cereals. K-State has proprietary intellectual property in this area. Related collaborative efforts are already in place with the International Rice Research Institute in the Philippines and the International Corn and Wheat Center in Mexico. Additionally, K-State has unique scientific expertise in the genetics of mycotoxin production in the fungal pathogen *Fusarium*; expertise that is being applied to develop protective measures against these insidious toxins.

K-State has a long-standing program in pre- and post-harvest food safety, which links veterinarians and animal scientists in statewide and regional efforts to protect our food animals and domestic food supply. Improved state-of-the-art diagnostic tools for infectious agents and foodborne pathogens are under development continuously. Innovative infrared imaging technologies are being applied to the cattle and swine production industries for the purpose of screening health and other production parameters. Commercial applications for steam pasteurization of adulterated carcasses were perfected at K-State, and uses for electronic pasteurization are being evaluated. To deal with endemic and emerging biological threats, K-State scientists are working on detection, prevention, and rapid response methods from the feedlot to the market place.

We're building strategic partnerships with private sector entities with a stake in food safety and security. We have ongoing research, licensing, and training arrangements with major corporate partners in the food crop, food animal, and food safety arena. We partner with small firms as well. Steris FoodLabs, a food safety firm started in Manhattan, provides chemical and microbiological testing services as well as HACCP validation and verification. It's located in Manhattan because of the broad-based food safety expertise at K-State. Nantek, a local startup company based on university intellectual property, has numerous formulations of reactive small molecules that can be deployed to destroy toxic chemicals. Some of these materials destroy nerve gas almost instantly. Others have

bioreactive capabilities, inactivating anthrax spores and various plant pathogens in a matter of minutes. Nantek countermeasures have proven broadly effective.

K-State, through our Electronics Design Laboratory, is working with Sandia National Laboratory on the remote detection of biological materials. We are helping to design components for an airborne ultraviolet laser detection system for biological weapon aerosols. This technology is likely to have broad applications in protecting the U.S. from biological weapons of various types.

University representatives have met with the Kansas Attorney General and the Kansas Bureau of Investigation to discuss agricultural forensic needs K-State might provide in addressing the biological weapons threat. We joined with the University of Kansas Medical Center to become part of the national Agromedicine Public Health Consortium, in an effort to provide better health protect for our rural agricultural workers. We have a well-established crisis communication network, which could be crucial in dealing with a bioterrorist attack. We've established a military graduate student recruitment program to increase the pool of highly qualified and motivated students to work on homeland defense and other contemporary research issues.

We're developing graduate certificate programs targeted to food safety and security. Food safety experts from around the country and the world congregate in Manhattan each summer for a hands-on workshop to learn about the latest food safety technologies; next year will mark the 20th anniversary of this program. Food safety and HACCP training modules are also being adapted for distance delivery.

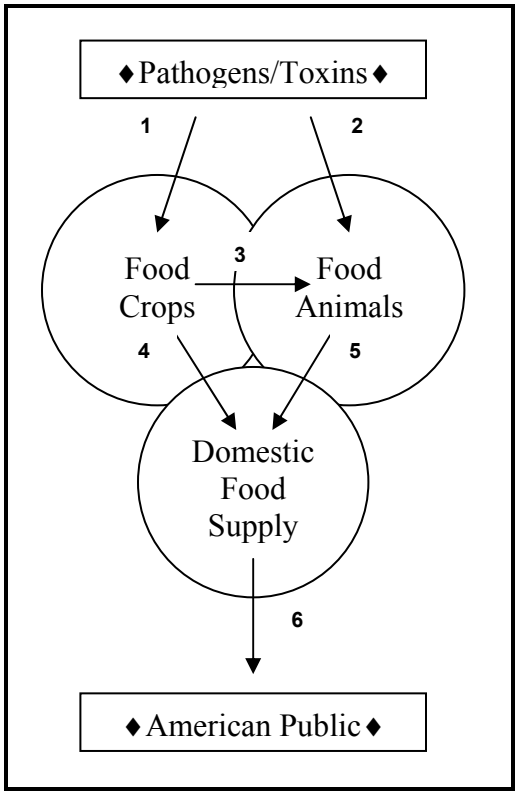
In addition to being a member of the national Agricultural Distance Education Consortium, K-State has launched a pioneering distance education initiative via Internet-2. This real-time effort links instructors and students at K-State, Nebraska, and Oregon State (three land-grant universities) to teach the genetics of resistant and susceptible interactions between food crops and the bacteria, viruses, and fungi that attack them. This topic has immediate applications to the agricultural biological weapons threat. Moreover, perfecting this broad-bandwidth instructional approach will allow the whole land-grant system and other stakeholders to be brought up to speed quickly on complex homeland defense imperatives.

It is our belief that K-State will not be able to fulfill one of the most important land-grant missions of the next millennium if we are not prepared to deal with emerging threats to our agricultural resources. The most daunting challenges may well involve agricultural bioterrorism.

We trust that we have alerted the Subcommittee to the gravity of the threat that looms over our nation's food supply – *the threat that looms over the world's food supply and the global economy*. America has the capacity to meet and defeat this threat, but the time for concerted action is now.

ATTACHMENT A

1. THREATS POSED BY ENDEMIC & EXOTIC PATHOGENS AND/OR TOXINS:



THREATS [NUMBERS 1-6 IN THE DIAGRAM]:

1. a) Plant pathogens or toxins transmitted to food crops.
   b) Animal pathogens or toxins transmitted pre- or post-harvest to food crops.
   c) Human pathogens or toxins transmitted pre- or post-harvest to food crops.
2. a) Animal pathogens or toxins transmitted to food animals.
   b) Human pathogens or toxins transmitted pre- or post-harvest to food animals.
3. a) Plant pathogen or toxin-induced losses of crops to feed animals.
   b) Animal pathogens or toxins transmitted via crops to food animals.
4. a) Plant pathogen or toxin-induced losses of crops for the domestic/global food supply.
   b) Human pathogens or toxins introduced into the food supply from food crop products.
5. a) Animal pathogen or toxin-induced losses of food animals for the domestic/global food supply.
   b) Human pathogens or toxins introduced into the food supply from food animal products.
6. Human pathogens or toxins transmitted to the America public.

2. UNIVERSITY EXPERTISE RELEVANT TO ENDEMIC & EMERGING THREATS:

FOOD SECURITY & PREPAREDNESS NEEDS

- Advanced professional expertise
  - Animal diseases/toxicology
  - Crop plant diseases/pathobiology
  - Decontamination/detoxification
  - Food safety for food animals & crops
  - Microbiology/immunology
- Biological agent surveillance
  - Forensic tools and reagents
  - Remote detection
- Broad bandwidth data transmission
- Civil-military response training
- Crisis communication management
- Economic outcome assessment
- Public health planning & programs

UNIVERSITY RESOURCES & EXPERTISE

- Research/advanced education programs
  - Veterinary medicine/animal science
  - Plant biotechnology/grain science
  - Biological countermeasures research
  - Pre- & post-harvest food safety/HACCP
  - Distributed expertise and programs
- Broad-based interdisciplinary expertise
  - Biological & molecular diagnostics
  - Electronic detection design & GIS
- Internet II & satellite downlinks
- Food safety exigency planning & response
- Extension & continuing education resources
- Agricultural economic modeling & analysis
- National agromedicine consortium

ATTACHMENT B

BIOGRAPHICAL SKETCHES OF THE KSU SCIENTIFIC ADVISORY TEAM:

R.W. TREWYN, PHD, is Vice Provost for Research and Dean of the Graduate School at Kansas State University and President of the KSU Research Foundation. After serving as a staff sergeant in the infantry in Vietnam, he obtained his PhD from Oregon State University in 1974. He conducted research at the University of Colorado Health Sciences Center, then joined the medical school faculty at Ohio State University in 1978, attaining the rank of Professor of Medical Biochemistry in 1988. His research efforts focused on the molecular and cellular events involved in cancer development and treatment. In 1994, he assumed the positions of Associate Vice Provost for Research and Professor of Biology at Kansas State. He became President of the Research Foundation in 1995 and Vice Provost and Dean in 1998.

RALPH C. RICHARDSON, DVM, is Dean of the College of Veterinary Medicine of Kansas State University. He obtained his DVM in veterinary medicine at Kansas State University in 1970, and completed an internship (Purdue University, 1973) and a residency (University of Missouri-Columbia, 1975) in small animal medicine. He was captain in the U.S. Army Veterinary Corp. Following several years in private practice, he joined the faculty of the School of Veterinary Medicine of Purdue University. He attained the position of Head of Veterinary Clinical Sciences, before joining Kansas State University as Dean of the College of Veterinary Medicine in 1998. He has research expertise if the areas of comparative oncology and clinical trials, with more than 35 scholarly journal articles and book chapters.

ROBERT S. ZEIGLER, PHD, is Head of the Department of Plant Pathology and Director of the Plant Biotechnology program. He obtained his PhD from Cornell in 1982. He has spent 20 years in research and research management in tropical developing countries primarily with the International Rice Research Center (IRRI) in the Philippines and the International Center for Tropical Agriculture (CIAT) in Colombia. His research has been principally on rice diseases, and the main focus of his research has been on rice blast disease – one of six fungal plant pathogens of serious bioterrorism concern. Research domains in rice blast include fungal pathogen population genetics and genetics of durable host plant resistance – two critical areas for anti ag-bioterrorism efforts. As a research manager with global responsibilities, he has had very broad experience in plant pathogens of agricultural importance in the Americas, Africa and Asia.

JAMES L. MARSDEN, PHD, is the Regents' Distinguished Professor of Meat Science in the Department of Animal Science and Industry. He obtained his PhD in food science from Oklahoma State University in 1974. He advanced through a number of industrial positions over the next 15 years, and joined the American Meat Institute in 1989, first as Vice President, then as President in 1993. He was recruited to KSU in 1995. He is an internationally recognized expert on food safety and the Hazard Analysis and Critical Control Point (HACCP) system in the meat and poultry industry. As such, he has consulted and lectured extensively on these topics. He served as the Senior Scientific Advisor for the North American Meat Processors. He has provided expertise to help control insidious foodborne pathogen outbreaks in the U.S., and presented expert commentary to national news media about these events.

JERRY P. JAAX, DVM, is the University Research Compliance Officer and University Veterinarian of Kansas State University. He obtained his DVM from KSU in 1972 and became a Diplomate of the American College of Laboratory Animal Medicine in 1984. He is a graduate of the U.S. Army Command and General Staff College (1984), and has been a consultant to the Surgeon General of the Army for research animal care and use. Prior to returning to KSU in 1998, he was the Chief of the Veterinary Medicine Division of the United States Army Medical Research Institute of Infectious Diseases (USAMRIID), Ft. Detrick, MD, and Director of the Biological Arms Control Treaty Office at Ft. Detrick. He spent nearly 20 years working in medical defense against biowarfare (BW) agents, BW treaty compliance, and BW counterproliferation efforts. He is an expert in high-hazard animal care and use biocontainment, and as such, played a key leadership role in the emergency response and management of the Ebola virus emergence in Reston, VA. He is a retired Colonel in the U.S. Army Veterinary Corps.