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BEFORE THE
UNITED STATES HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE AND TECHNOLOGY
SUBCOMMITTEE ON SPACE AERONAUTICS

OVERSIGHT HEARING—INTERNATIONAL SPACE STATION PROGRAM

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Mr. Chairman and Members of the Subcommittee, I am Edward B. Knipling, Administrator of the Agricultural Research Service (ARS). ARS is the principal intramural science research agency of the United States Department of Agriculture (USDA). ARS operates a network of more than 100 Federal research laboratories across the Nation on all aspects of agricultural science.

Thank you for the opportunity to appear before the Subcommittee today to present testimony about ARS' collaboration with the National Aeronautics and Space Administration (NASA) on research relevant to agriculture and the space program.

ARS and NASA have a long history of working together. The ARS Beltsville Agricultural Research Center and the Goddard Space Flight Center are next-door neighbors in Maryland. ARS scientists at Beltsville and other ARS locations have worked with the NASA scientists in the Earth Observation program at Goddard and elsewhere to apply a wide range of remote sensing methods to environmental and agricultural problems.

Among our successes are predictions of animal disease (Rift Valley Fever) outbreaks based on global weather patterns, detection of drought indicators, remote measurement of crop yields, detection and risk assessment of plant pests and invasive species, and development of data for application of precision farming. The roles of ARS scientists in such collaborations have been to provide knowledge and interpretation of plant, animal, and environmental indicators recorded in the imagery and data collected by NASA's satellite and other aerial platform sensors, as well as how to effectively design and use these systems for meaningful environmental and biological assessments.

These research activities have been conducted under the framework of an existing Memorandum of Understanding (MOU) and predecessor agreements between USDA and NASA. Today I will speak of a planned new Memorandum of Understanding involving research collaborations in the agricultural life sciences that will take advantage of the microgravity environment of the International Space Station (ISS). Mr. Chairman, I will address four issues about this new collaboration between ARS and NASA that are of particular interest to this subcommittee.

Achievements Expected Under the New Collaboration
We anticipate that this research will lead to new understandings of biological cellular mechanisms and creative new ways to improve American agriculture, protect the environment, and contribute to human health. These will be based on principles related to the early development of cells and how that development is influenced by zero or reduced gravity compared to the earth's gravity environment.

Access to the facilities and environment of the ISS will provide ARS with new abilities to test biological processes in microgravity. Topics of immediate interest are development of plant and animal cells in culture and improved understanding of the capacity of such cells to express desired traits or to develop in specialized ways. Selection of cell lines under microgravity may provide germplasm capable of improving plant resistance to pathogens, improved growth characteristics, and generation of functional replacement organs.

How ARS and NASA Will Proceed on Significant Collaborations
ARS program managers and scientists have met with NASA program managers and scientists to define the areas of mutual interest. They have determined that for work on the ISS the ARS focus will be on the science of cells, principally the effects of microgravity on:

- basic biological mechanisms,
- genetic regulation in plants and animals cells,
- pathogenesis in both plants and animal cells,
- development of cells cultured to understand organ function and development , and
- selection of plant cells for desirable growth characteristics.

We expect to apply the findings and results of research in these areas to improving animal and plant productivity. We anticipate that our first collaborative research on the ISS will be to understand the effect of microgravity on the differentiation of animal germ cells. Our goal is to be able to produce undifferentiated cells that can be used to study gene expression, cellular differentiation, and to improve genetic enhancement technologies.

The Role of Agriculture in Space Research
We envision the tools of space research provided by NASA collaboration as a powerful means to better understand and deal with the responsibilities and challenges we face in agriculture as well as exploiting new opportunities. Our experiences with the development of remote sensing applications have proven this to be true. We expect that the microgravity environment on the ISS will provide the same kinds of benefits to help advance our agricultural life sciences programs and potential new applications. The ARS research mission and goals will not change but we will benefit from NASA collaboration and unique approaches to help reach those goals. The new MOU will specify that each

agency, ARS and NASA, shall provide their own resources, including expenditure of funding, to support their respective complementary part of the collaborative research.

How ARS Will Develop a Research Plan for Work on the ISS

Planning for this research on the ISS has begun. ARS has been involved at two levels: at the national planning level and at the investigator level. At the national level, ARS program managers have worked with NASA program managers to assure that the goals to be met would be relevant to problems of agriculture and to establish a formal relationship through a MOU. At the investigator level, NASA and ARS scientists have met and explored the possibilities for specific experiments to be conducted at the ISS. In particular ARS investigators are interested the development and differentiation of a particular set of cell lines that came from swine embryos and have been shown to give rise to liver cells. These cells may even be able to be used in artificial liver devices. Many questions about the regulation of their differentiation in culture remain unanswered. Research planning has focused on the design of experiment to ask questions about the role of gravity in cell culture differentiation.

Mr. Chairman, this completes my testimony. I will be pleased to address any questions you and Subcommittee Members may have.