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CHALLENGES IN THE FUTURE OF AGRICULTURE

Dr. Charles E. Hess

Assistant Secretary for Science and Education
U.S. Department of Agriculture
Washington, D.C.

It is my pleasure to be with the Caribbean Food Crops Society as you begin your second quarter century -- and to bring you greetings from the United States Secretary of Agriculture, Clayton Yeutter. You are an important organization because you represent cooperation among over 30 countries and among scientific disciplines (I suspect the second of those is the more difficult one to achieve).

You are aware, I am sure, that both the U.S. Department of Agriculture (through the Agricultural Research Service scientists present here in Puerto Rico) and the United States land grant university system (through the University of Puerto Rico) are represented here in Mayaguez. Another land grant school, the University of the Virgin Islands, is also in the region. The agricultural leader of that school, Dr. Darshan Padda, is Chairman of your Board of Directors as well.

Consider the unique roles which the Agricultural Research Service and these two universities serve for those of us on the mainland of the USA and you here in the Caribbean. Their research scientists and their educational and extension service co-workers are a bridge between us all. That bridge is a knowledge and technology bridge between the Atlantic and the Caribbean. It facilitates our learning about your aspirations, problems, and plans while we share ours with you.

The papers presented at your meeting this week are probably the most visible evidence of this. Another is the direct working relationship which you as scientists will develop. The ultimate goal is the same for all: a better life for those who live in the Caribbean region through cooperation and scientific progress for the welfare of mankind.

We have much to learn from each other. One of your members was explaining to me how the people of St. Lucia have developed a unique approach to the development of their banana industry. Government efforts, private opportunities, and marketing channels have all joined to give farmers new opportunities, new technologies, and economic incentives. It is exactly the kind of cooperative approach agriculture needs to adopt on many levels in order to deal with a future of dramatic and far-reaching change.

Tonight, I want to talk about some specific challenges in the future of agriculture and in the current agricultural

research environment. This is a particularly appropriate topic as USDA's Tropical Agriculture Research Station (TARS) here in Mayaguez is currently celebrating its 90th anniversary and looking back on past accomplishments as well as ahead to future achievements.

EXTERNALITIES

Over the years, I have concluded that if we truly want to understand the forces at work in motivating agricultural research and influencing its efforts to improve agriculture and its products, we need to go beyond a simple preoccupation with science. There are powerful externalities which supersede the control of individuals and even of institutions. They create pressure -- they influence policy -- and they often have both positive and negative effects upon agricultural research.

These externalities affect not only the way in which we do our work but what work we decide to do. Research policy is not formulated in any pure and solitary test tube. It springs from the messy and often disorderly real world of conflicting demands and unclear choices. Scientists no longer operate -- in fact, we probably never really did -- in isolation from an increasingly concerned public. Our course is continually influenced by the changing winds of public opinion and national and agricultural policy.

Let me give you an example. Some 40 years ago, when the United States Congress was formulating our farm bill, there were fewer players, only 3 or 4 major groups involved. Today, someone counted over 215 groups with active interest that are making their voices heard and are shaping policy. Maybe we do not necessarily need to learn any more about agriculture, but we may need to learn more about the world outside of agriculture and how it affects us. Many of the broad concerns which we have in the USA are concerns of yours too -- and they affect agricultural research.

COMPETITIVENESS

For example, look at the current focus on the importance of international competitiveness and trade. More specifically, many Caribbean countries are looking to become more self-sufficient by reducing imports and increasing local production. It is obvious that these concerns are pushing research to play a vital role in such areas as reduced production costs and enhanced product quality.

Each nation needs every ounce of careful management and efficient technology it can muster to maintain its competitiveness in a tough global marketplace and at the same time have an environmentally sensitive agriculture. This means continued work on increased efficiency.

Here at TARS, detailed studies on the agronomy, breeding, and plant protection of corn, sorghum, and millet have resulted in the development of superior material with high yielding potentials and resistance to many diseases and pests. And these results have not stayed bottled up in the laboratory. Project personnel have aided local farmers who are interested in growing these crops on a commercial scale.

Through research, we can also develop agricultural products which are less expensive, more appealing to consumers, and more nutritious. To be competitive, we may need to make some changes to adjust to shifting consumer trends and demands. For example, work on beans at TARS has developed multiple disease resistance and improved their nutritional content (high protein and low tannin). Honduras and the Dominican Republic are countries which have received direct benefit from the TARS bean breeding programs.

Not only are scientists trying to improve the quality of agricultural products, but we are concerned about maintaining that quality during processing, transportation and marketing. New technology in these areas will increase shelf life, facilitate transportation and insure continued low-cost year-round availability. Scientists in California are using biotechnology to "turn off" the production of the enzyme which causes tomatoes to get too soft during shipment. When this trait is incorporated into commercial varieties, we may get back the taste, smell, and texture of a vine-ripened tomato in store-bought fruit.

ENVIRONMENT

The environment is another major area in which national and international policy are influencing science policy and research. Though technology has helped agriculture to become an efficient food fiber, and forest system which feeds and clothes the world, we now recognize that technology has had some costs which were not fully anticipated at the time of its introduction.

As science has fine-tuned its instrumentation and its abilities to track and detect smaller concentrations of contaminants in our food, our ground water, and our environment, we are becoming more and more sensitive to the social, environmental, and health implications of agriculture. The preservation of our environment is a pressing issue affecting the entire world -- and few of us live in a closer day-to-day relationship with our planet or depend more directly on maintaining a quality environment, than those involved in agriculture.

In the US, environmental concerns were strongly reflected in the sodbuster and swampbuster provision of the 1985 Farm Bill--

and they are even more strongly present in the debates going on now over the current farm legislation. And concern is growing worldwide. Acid rain, global change, and soil erosion do not respect national boundaries.

It is time for all of us in agriculture to be proactive rather than defensive, not only do our future abilities to produce food depend on it, but to do otherwise is to invite restrictive legislation and regulation which may remove our decision-making power and constrain our flexibility to adopt management practices which best fit each farming situation. In this vein, USDA is pleased to be working in close cooperation with the University of Puerto Rico and the Commonwealth of Puerto Rico to develop systems to maximize the utilization and conservation of natural tropical resources, and to improve the long-term use, conservation, and management of tropical plants and soils.

SUSTAINABLE AGRICULTURE

Overall, agriculture is endeavoring to operate in an environmentally responsible fashion while continuing to produce both economically and profitably. The concept of sustainable agriculture is most emphatically not a return to "low tech" production methods. On the contrary, it is the use of the very best of technology in a balanced, well-managed, and environmentally responsible system. Input will be needed from all agricultural sciences to reduce the impact of agricultural production systems on the environment through genetically modifying plants to be insect-, disease-, and stress-resistant.

TARS plays an important role in this vast endeavor through its germplasm development program. The winter nurseries at Isabela (with the involvement of over 20 US research organizations and universities) provide scientists a unique opportunity to accelerate the development of new lines, hybrids, and varieties.

WATER QUALITY

One of the reasons that sustainable agriculture is coming to the fore is a very real public concern about reports of contamination of ground and surface water resources by agricultural chemicals and nutrients. In the United States, President Bush has identified the protection of water resources as a high priority item and has made it clear that farmers are ultimately responsible for avoiding contamination of water as a result of their land management practices.

His Water Quality Initiative aims to protect ground and surface waters from contamination by agricultural chemicals and wastes, especially pesticides and nutrients. It combines the expertise of agencies from four federal departments to provide

farmers, ranchers, and foresters with the knowledge and technical means to respond independently and voluntarily to on-farm environmental concerns and requirements. In meeting this goal of maintaining agricultural productivity, avoiding economic hardship, and sustaining an economical and safe supply of food and fiber, biotechnology can again be a major tool to help decrease the need for chemical fertilizer and pesticides.

In addition, bioremediation is becoming a new buzzword in town. Selecting or modifying organisms to detoxify or break down toxic substances in situ is a better alternative for example, than digging up an entire area of contaminated soil and transporting it to someone else's backyard to be treated. This could help clean up dumps where waste pesticides and other toxic substances were disposed of prior to the appreciation of their potential for ground water contamination. An example from right off the front page is the recent trial use of "oil-eating" bacteria in the oil spill in the gulf near Texas.

FOOD SAFETY

In addition to water quality, many people are tremendously concerned about the safety of the food they eat. They are increasingly anxious about conflicting reports on pesticides, chemicals, and residues. Furthermore, chemical residues on food items, especially fresh fruits and vegetables, cause public alarm and major disruptions of market channels. Two contaminated grapes from Chile found on table grapes destined for US grocery stores caused economic chaos for the grape growers in Chile. Likewise a chemical residue on apples from orchards in the United States resulted in some supermarket chains refusing to sell an otherwise desirable crop. It is happening more often as analytical capabilities become more definitive.

Naturally, all nations seek a safe and reliable food supply for their people. Yet, the balance between risk and safety has been tipping too far in one direction. We are being challenged to get across to the public that we don't live in a totally risk-free environment, that one in a million are not bad odds. We also need to stress that the use of technology helps keep food costs down. We need more research to reduce pesticide use and eliminate such problems. At the same time, we need to prevent the spread of new pests. Research has a role to play in both aspects.

In the United States, we are working to gain more information on the problem. In our 1991 budget, currently being reviewed by Congress, we have proposed a program to accurately determine the true facts in the food safety issue. We will work with states to develop market basket studies of fruits and vegetables to ascertain what residues may be present so we can deal with facts rather than speculation.

At the same time, we want to give increased emphasis to Integrated Pest Management (IPM). This involves developing new systems of control as well as speeding up the adoption of existing programs.

The new tools of biotechnology can help to speed the development of genetic resistance to insects and disease. An example of biocontrol involves the biological control Dipel. As you know, its biological activity comes from a protein produced by the bacteria Bacillus thuringensis. The biological effectiveness of Dipel was limited because it was inactivated by the ultraviolet component of sunlight. Thanks to genetic engineering, we now have tomato plants that produce the toxic protein in their own leaves -- where it is protected from light by the chlorophyll. This breakthrough increases efficiency by cutting production costs and protects the environment by reducing heavy dependence on pesticides.

We are not seeking to eliminate the use of important chemicals and fertilizers. In many instances, they are absolutely necessary to the farmer. We are, however, seeking ways to reduce their usage and increase their effectiveness in order to improve and maintain environmental and economic sustainability. We must now include environmental impacts in the cost/benefit equation -- something that has not always been considered in the past.

GLOBAL CHANGE

On an even larger scale, the public is paying close attention to the role agricultural practices play in global change. It is a high priority in Washington, both in Congress and at USDA.

While there is still considerable debate about whether there will actually be climate change or global warming, there is no question that we have dramatically increased the levels of CO_2 and other greenhouse gases which have the potential of modifying our environment. For example, we know from horticultural research that enriching the atmosphere in a greenhouse increases plant growth and development.

Agriculture has three important roles to play in global change. In the first place, it clearly contributes to the accumulation of greenhouse gases through the production of methane from ruminant livestock and paddy rice productivity, and of nitrous oxide, a by-product of nitrogen fertilization. Research on more efficient fertilization practices would help reduce this gas by-product, as well as decrease potential groundwater contamination.

The second role for agriculture is to prepare itself to adapt if there is climate change. We can do that through the

development of stress-resistant plants -- adding traits such as drought and temperature tolerance to trees, shrubs, flowers, and crops. Results of this type of research have already extended the range of climates in which we are able to grow selected plants. And certainly, the possibility of global change increases the importance of the work you are all doing on tropical and subtropical crop and soil systems.

Third, is the positive role agriculture can play in mitigating the impact of climate changes by sequestering CO_2 through photosynthesis. In addition trees and other plants can be a source of biomass for alternative fuels and for carbon-based chemical feedstocks used in the industry -- recycling carbon dioxide, as well as replacing fossil fuels, the use of which simply adds more CO_2 to the environment.

PUBLIC PERCEPTION OF TECHNOLOGY

It is ironic that some of the best new tools we have to help address the challenge of feeding and clothing a growing world population on a finite amount of land in an environmentally sensitive manner are being attacked under the banner of environmental, economic, and social concerns.

With all the possible benefits of biotechnology, anxiety on the part of a concerned public still exists. And unfortunately, it is often based upon the perception of risk rather than the reality. To my mind, this is one of the single most critical issues confronting biotechnology. Some people seem to forget that the ultimate beneficiary of research in areas such as biotechnology which increase food production efficiency is the consumer -- who enjoys inexpensive, wholesome, and safe food which can be produced in a way that is environmentally sound.

Look at the onslaught that was unleashed by some groups against the use of bovine somatotropin (BST). And this after findings by the US Food and Drug Administration (FDA) and agricultural scientists both in the private sector and universities that there should be no arbitrary prohibitions placed upon its development, particularly from a health viewpoint. Yet, two states, Wisconsin and Minnesota, have placed a one-year moratorium on the commercial use of BST. Unfortunately, the question is colored by emotion and misunderstanding rather than grounded in scientific fact. We have seen a similar approach aimed at restricting research on herbicide-resistant plants.

For example, there are proposals in the Farm Bill to establish "the purposes of research" which include the statement that federally funded agricultural research and extension programs shall "...contribute to a more equitable rural, social, and economic structure, and enhance the social and economic vivacity and quality of life of rural commununities." USDA would

be required to write regulations ensuring that our research is directed to the purposes listed in the bill. Researchers would have to project how their research would affect or further the specific purposes of research as presented in the Farm Bill.

This concept of broad legislated restriction of agricultural research is a dangerous principle which will most certainly have the effect of constraining the freedom of scientific inquiry and reducing the potential for the discovery of valuable new information. Once you start down the slippery path of placing a priori limitations on what research we can or cannot do, each special interest group will want to limit inquiry into areas which may have an effect upon them. Examples we have already seen include objections to mechanization research, animal rights, and BST, which I have already mentioned.

Certainly we have to be economically, environmentally, and socially responsible, but we don't do it by stopping research in its track. To my mind the better approach is: 1) to educate the public and address their valid concerns, 2) to conduct studies to determine the socio-economic consequences of various new technologies, and 3) to identify ways to mitigate any possible adverse effects.

BIOTECHNOLOGY

The recent discoveries of biotechnology offer a powerful yet precise set of new tools to use in agriculture's ongoing endeavor to feed and clothe the world and to meet the external challenges facing it. At the moment, we are only beginning to explore the diverse applications of these tools, but biotechnology may one day have a greater impact on our lives than any other technological advance of the 20th century, Yet with this great potential comes an even -- greater challenge -- to meet broadly accepted societal goals while at the same time protecting human health and the environment. Nowhere is this challenge more keenly felt than in the application of biotechnology to agriculture. And it is a challenge we are attempting to meet through the development of oversight procedures and guidelines on the field testing of genetically-modified organisms.

Previously existing methods of gene transfer have been used for decades to alter plants and animals to better serve human needs. The new techniques of biotechnology involve no radical departure from historical practices, but simply enable scientists to do the same things they have always done -- but more precisely, more quickly, and drawing from a broader range of germplasm. It is reasonable to expect that the new tools will continue to be used in this same way.

In 1965 Nobel laureate Francois Jacob observed: "A revolution in science is not simply an accumulation of data, a harvest of results, a change in the landscape. It is a change in the way people think, in the way they look at things. It is a change in vision itself."

That kind of change of vision is what we want to bring about. My own experience has been that the more people understand about science the more they feel positive about it. And the communication of that knowledge is up to us. We need more scientists like the late Sir Peter Medawar. I am not talking simply about his Nobel prize-winning work, but about his passion to, as one reviewer put it, "explain his work and his world to the rest of us." People can't generally understand science unless scientists make it understandable.

When a consumer is knowledgeable and informed, the word biotechnology in connection with food should not raise a red flag of fear, but rather conjure up thoughts of lower food costs, safer food, more nutritious food supplies, and a healthier environment. "Natural" does not always mean good, and "technology" does not always mean bad. The public needs to understand that a genetically engineered cow is still a cow, that a genetically engineered tomato is still a tomato, and that this research is being conducted by responsible, caring scientists working under a safe, strict, and credible system of operation in the pursuit of biotechnology's benefits for mankind and our world.

HUMAN CAPITAL

Speaking of public understanding of science leads me to another topic I want to touch on briefly: the need to attract young people into the agricultural sciences. They are the lifeblood of our future.

Under the ARS CBI Fellowship Program recent Caribbean Basin college graduates are recruited to spend a maximum of two years as research affiliates or fellows in an ARS laboratory working under the direction of a senior ARS scientist. They are trained in diverse agricultural enterprises of economic importance for Puerto Rico and the Caribbean Basin. The aim is to promote cooperation and communication between ARS and agricultural universities and research institutions in the Caribbean and to prepare young scientists to assume leadership positions in agriculture in the scientific community in this area.

CONCLUSION

On August 3, 1492, nearly 500 years ago, Christopher Columbus set sail from Spain. He found a new world (in fact on one trip, he landed not too far north of where we are today). As

they say, the rest is history. That's not news to any of us, but the point I want to make is this: Though we all recall the famous explorer who made the voyage, how many of us give a thought to Queen Isabella of Spain? After all, it was her government that funded the expedition.

From ancient civilizations to our current technologically advanced societies, national leaders have understood that new scientific knowledge can be a tremendous instrument of national strength and public good. Today, most nations continue to see their futures based on scientific and technological progress and innovation. And this means a substantial dollar investment in research and education -- and fortunately for us all, Isabella recognized that.

And we recognize it today. We simply cannot afford to underinvest in research -- especially in agricultural research which has such a high investment/return ratio. And we cannot afford to have research progress preempted by a priori prohibitions, or endangered by irrational public concerns.

Increased investment in agricultural research is a necessary investment in the future. The work must go on. It is a requirement if we are to meet the challenges facing agriculture around the world to be both economically successful and environmentally sensitive. It is important to us in the United States that our Caribbean neighbors be aware of what we see as important and changing directions and concerns -- and that you make us equally aware of your courses of action and your issues.

We are seeing the increasing globalization of agriculture. We are all moving into the future and broadening the entire vision of what agriculture can and should be. I am proud that the United States and the USDA can communicate and cooperate with you in these efforts. I see a challenging and rewarding future ahead for us all.