SOLVING YOUR PROBLEMS WITH RESEARCH AND EXTENSION TEAMS

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The title of this talk is "Solving Your Problems with Research and Extension Teams," but it could just as easily have been "How WSU Spends $1,500,000 Annually on Potato Research and About $500,000 Annually on Potato Extension." How is this research and extension directed to benefit the growers? Who provides the support? What is WSU planning for the next biennium? I'm going to spend a few minutes talking about the research and extension programs, some success stories that have directly benefitted the industry, the current status in our goals to support the potato industry, the science of the future and what it means to you, and WSU's current initiatives in the state legislature.

First, let's look at an example of the entire potato production, storage, processing, distribution, and marketing system in a cartoon. We've been hearing in the news recently about how the Russian economy is suffering and the people are going through a hunger-filled winter. Recently Time magazine sketched the scenario with this cartoon, "Yes, we have no potatoes." Limited yields in the field, reductions due to bruising in harvest, diseases in storage, losses in transportation, theft at all stages, weaknesses in the distribution, processing, and marketing system, and poor quality at the final product means that less than 25% of the potatoes harvested end up on the shelves to the consumer.

In contrast, I might note the over 2% increase per acre in Washington over the last 40 years. This consistent pattern of yield increases exists in the U.S. primarily because of your ability to grow an outstanding product, but indirectly because of the research, extension, and technology support system that exists through the Agriculture Experiment Station, the Cooperative Extension Service, and the Agricultural Research Service. In our region, the tri-state cooperation as well as the Agricultural Research Service provide an integrated, inter-locking, and complementary program of breeding, management, harvesting, processing, disease control, and quality control at all stages in the production process.

WSU and the Agricultural Research Center and our Cooperative Extension are only part of this integrated system, but I'm going to focus on this one part. In 1990, our agricultural research programs expended $1.5 million in potato research and approximately another $.5 million by Cooperative Extension in disseminating the information and educating growers about agricultural production in potatoes.

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The research support comes from multiple sources. The state provides about 38%, federal special grants generated as a result of congressional support about 20%. About 20% comes from the industry through commodity commission support. 4% comes from the federal formula funds--the Hatch funds that come directly to the Agricultural Experiment Station and which I allocate to projects. And just under 20% comes to scientists who conduct basic research science that will benefit you, if not today in solving your problems, then 10 years down the road.

To give you a sense of how the potato research programs differ from all other research programs, in 1990 about 45% of our funds were from the state; 10% from federal formula funds; 20% from federal grants; and 17% from non-federal grants, the commodity commissions and other industrial, corporate, and state sources; and about 6% from the sale of products that we roll right over into research programs.

The grants are absolutely essential to support our program. In 1989-90, the Washington Potato Commission provided $323,000 in research support; in 1991 as a result of the passage of the increased assessment on potatoes, the Commission provided $422,000; we are requesting in 1991-92, $676,000 to do a better job in solving your problems.

These grants obviously supplement, augment, and complement the funding from federal and state sources. They extend the scope of the program and accelerate the progress of on-going work. The federal grants, especially the NSF and USDA competitive grants in basic research, permit the scientists to initiate high-risk projects. These grants increase the depth and breadth of our programs and support the team efforts.

In 1990, we had 24 research projects addressing basic and applied problems associated with potato production, 4.8 scientists years, this means that some part of 18 research scientists is dedicated to potato research and 6 ARS scientists, located at Prosser and Yakima. The potato research program is 4.6% of the Ag Research Center's overall research activities.

What are some of the specific topics we have been engaged in in the last 30 years as yields have climbed over the decades?

(1) Managing the harvest of potatoes. Concepts developed from research in Horticulture and Landscape Architecture and Agricultural Engineering have been transferred to the industry and achieved substantial reduction in tuber damage during harvest and handling. One study shows the damage accumulations as tubers move from the field through the harvester, truck, and piling equipment to the storage pile for 1978 and 1986 harvest seasons in the northern Columbia Basin. The 1978 data are from six different growers that were considered typical. The 1986 data are from five different operations that were to some extent applying the principles of eliminating soil early and keeping the conveyor filled with tubers. Their equipment was up to date and kept in good repair. Note that the later data show damage levels at 25% in the storage pile while the earlier data show a level of 45% at that point.

Many growers are able to do even better than this slide shows, achieving into-storage damage levels as low as 10%, i.e., 90% bruise free. Washington's 1989 potato crop was worth nearly $322 million. Each 1% of that crop that was saved because of tuber-damage reduction measures was worth over $3 million to the growers. That additional value occurs every year. The potato research dollars are returning 1000% on the investment on bruise-reduction research alone.

I would like to make a point about the $1.5 million invested in research. This is less than a one-half of one percent invested in research and development of the farm-gate value of the product. No other industry underinvests, yes underinvests, so heavily in its research and development. I do not blame the growers for this; but I fault the state and the federal government for an inadequate investment in the fundamental industry supporting our food system. In microelectronics, 12-15% investment in research and development of the value of the initial sale of products is the norm. Even in stable, mature industries in manufacturing, such as autos, the average is 2½% of the value of sales which would be invested in research and development. One of the reasons we have such extraordinary returns on our investment is the limited investment.

Most recently, Dr. Gary Hyde is using an instrument sphere that measures impacts in fruit and vegetable handling equipment. It is helping us to determine design requirements for new handling equipment that will be highly productive but still handle potatoes gently and minimize bruising. the sphere is also helping us to determine more about tuber damage resistance and how to improve it.

(2) Potato seed sizing and spacing. Research and extension efforts by Horticulture and Agricultural Engineering have identified the problem areas in the cutting of seed tubers, developed operation and management options to minimize these problems, and evaluated the results. Reducing undersized seed increases your yields and improves your income. Two case studies last year by Cooperative Extension show that, when a grower cut undersized seed by 40%, his yields improve 10 tons per acre or approximately $800 per acre. A second grower by adjusting his seed cutter appropriately reduced poor seed 35% and upped his yield by nearly 25%.

Seed placement is similarly an essential element in optimizing production. The economic evaluation identified the costs and the solution to these problems, and it's very clear that the solution would be economically beneficial.

(3) Quality of seed and quality of cultivars. Seedlot evaluation has been an essential part of our extension programs to show the grower the value of quality certified seed through side-by-side evaluation. Similarly, expanded efforts to identify desirable clones and cultivars in the tri-state region along with the required cultural practice modification to maximize the genetic potential have led to a multiple cultivar industry versus previous limited cultivar industry.

(4) Tuber quality. Despite its many qualities and level of importance for fresh and processing markets, Russet Burbank is susceptible to a number of external and internal tuber disorders. WSU research has shown the relationship of cool soils and air temperatures during tuber initiation as causing brown center.

Larry Hiller's research has determined that cell size, cell wall thickness, and tuber growth rate differ among various cultivars and breeding lines and may account for differences in susceptibility. Identifying the cause and finding a solution is essential to maintain quality.

(5) Disease control. Pathogens such as root knot nematodes, especially the Columbia root knot nematode and the northern root knot nematode, can deciminate on a potato crop. Identification of the pathogen, understanding its basic biology and ecology, determining the best means to control them and the most efficient use of available nematicides, searching for less costly nematicides, and identifying nematode resistance in potatoes and potato rotational crops all give the grower an opportunity to increase yields with reductions in losses. Economists have estimated that, without root knot nematode control, losses would be annually in excess of $40 million. Even taking into account the costs of soil fumigants, the industry benefits significantly annually. Identifying less expensive, non-fumigant insecticides has resulted in further savings and benefits to the grower.

Finally, Cooperative Extension plays a day-to-day role in your life. Field educational events provide only one of the many vehicles by which leading-edge technology is transferred to the Washington potato industry. Additional events include: the annual potato conference, on-farm demonstration plots, and workshops such as the potato IPM program.

Current status. This brings me to the next section. We've reorganized this year our potato research program, not that I think it was poorly managed and organized but because it is clear that we need to increase the interaction among the faculty so that we can be more efficient in our research programs and also so that the questions are being asked across an array of scientific programs with an eye to solving multiple problems that exist. Last year the potato research problems meeting and the potato research council indicated that there were four major issues that they would like WSU to address: (1) the loss of chemicals and alternative pest management strategies, (2) quality at all stages of the seed, of the clones, of the tubers, of the post-harvest product, (3) disease control, and (4) plant nutrients, soil quality and irrigation. To solve such problems, we needed to create research teams rather than single, individual or even cooperating faculty groups working on projects.

I might briefly give you an example from the wheat industry. Two years ago I brought together for an afternoon all the faculty involved in trying to solve the problem of TCK Smut on wheat. It is a major problem because it prevents export of wheat products to China. As we sat around the table discussing the problem, the Agricultural Engineers asked the world-renowned expert on smuts a simple question, "How does the smut attach itself and hold itself to the wheat seed?" The expert indicated he hadn't thought about that question. But the Ag Engineers were interested in that question because they could see the possibility of separating the smut spore from the wheat seed through some process. If it were an electrical charge, through some countercharge; if it were by some mechanical adhesive, through some dissolving strategy.

Beginning with that simple question, we reorganized our whole program. We continued the breeding-for-resistance activities, but we focused our seed technology program on identifying a viable smut spore, and killing it, and the Agricultural Engineering and Plant Pathology programs worked on separating the spore through some mechanical process that would be extraordinarily rapid, efficient, and clean yielding a product that one could test and aim for a zero-clearance level. These teams have been working for 2 years and have identified mechanisms for killing the spore and are working now on scale-up models in the laboratory for handling the tons of wheat that would have to be processed prior to shipping.

I use this as an example of just the kinds of cross-fertilization that can occur intellectually when teams of faculty are brought together. We organized teams along the four areas that were considered high priority and began this process in support of the potato industry. These proposals are part of the potato research review you will consider next week.

The future. WSU's basic scientists, some funded by the Potato Commission and some funded by external grants and contracts, have been moving aggressively in the area of identifying the genes that give a plant resistance to the diseases and insects that attack it. Classical breeding and genetic resistance through molecular biology and biotechnology are a natural relationship. The corporate sector is moving this direction vary rapidly as witnessed by some of Monsanto's breakthroughs in which they have incorporated the Bt gene in potatoes which releases the toxin that kills the Colorado potato beetle.

At WSU, Lee Hadwiger has been examining pea genes which give the pea resistance to many potato diseases. He has transferred pea gene 49 to the potato plant along with the control segment, which allows the gene to turn on when in contact with the pathogen. We can expect this potato plant to resist potato pathogens more successfully since it was a part of the resistance expression when peas were resisting potato pathogens. Tubers from this and other plants will be tested at Prosser in cooperation with Mark Martin this year. We don't know if this gene 49 alone can protect the potato; if not, he will keep adding and combining genes until we get total resistance; this is the wave of the future.

Norm Lewis, a new faculty member and chairman of the Institute of Biological Chemistry, receives his funding from the Department of Energy and National Science Foundation, and he's studying phenolics. These compounds maintain the structural integrity of plant tissue, limit water loss, and again are a defensive barrier to pathogens. Suberin, which is abundant in the outer tissues of potato and is responsible for warding off pathogens attacks, is one material he is studying

Dr. Bud Ryan, the only National Academy of Sciences member at WSU, has done some extraordinarily exciting work on plant defense responses. He discovered the potato proteinase inhibitors I and II. These potato inhibitors prevent the larvae from digesting the food, they are called proteinase inhibitors.

They exist in potatoes, tomatoes, and other plants. Here the manducasexta (tobacco hornworm) larvae are eating on leaves of tobacco transformed with potato inhibitors II genes, in contrast to the wild type of tobacco with no genes of the potato inhibitor II. The middle plants are transformed as in the first slide, and the outer plants with no potato inhibitors are the ones the larvae are attacking. In these experiments, many of the small larvae simply died from starvation.

A second recent breakthrough in his research has involved the identification of a volatile, plant-produced oil called methyl jasmonate, a common perfume ingredient, which can spread through the air to induce nearby plants to manufacture insect-thwarting compounds, the proteinase inhibitors. A drop, a millionth of an ounce, is placed on a wick, incubated under light, and the response to this chemical by nearby plants is an increase in the inhibitors I and II.

To quote Dr. Ryan, "the results offer a biochemical basis for previously unrecognized form of defense gene regulation involving interplant communication." What does this mean to you potentially? A nonchemical mechanism for turning on the potato genes to resist the insect. It's a long way between the basic science identification of such a chemical and the actual production and use in the field, the registration of such a chemical, the residue analysis associated with it, and the actual approval by EPA and use by farmers. But this is the direction science is moving. In fact, field trials with alfalfa are already underway.

WSU initiatives and state legislature. We had a series of task-force meetings and town-hall meetings last year and arrived at three important areas that the general public, the industry, and our scientists feel that we should be directing our resources. (1) Sustaining agriculture and natural resources, a fundamental rationale for our existence (the context of agricultural production); (2) Family well-being, and (3) Rural growth and revitalization. We are seeking additional resources this biennium from the state legislature. We have had an exciting and very positive response from the state legislature. Two bills are currently being considered by the house and the senate to invest $7.8 million in the '91-93 biennium in our research and extension program. This would establish a center for sustaining and natural resources, which is focused on finding alternatives to chemicals in the management of insects and diseases, through biological control, plant breeding for insect and disease resistance, and nonchemical strategies for managing production practices. This new funding would enhance our programs of land stewardship and water quality and the safety and quality of our food supply. A core element of this new funding would support a food and environmental quality lab that would assist in the reregistration of pesticides.

Past, present, and the future. We appreciate your support in the past and we hope that you will continue to support us in our request to the state legislature and with increased funding from the Washington State Potato Commission so that our research can be conducted and its results extended to you.