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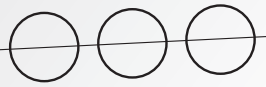

BRIEFING PAPER SERIES / *Research & Scholarship*

Safeguarding Our Food Supply—Protecting Our Health

FEATURED FACULTY

Byung-Kee Baik
Doug Call
Brady Carter
Rowland Cobbold
Chris Davies
Robert Gallagher
Kulvinder Gill
Stephen Jones
Kim Kidwell
Marcia Ostrom
Renee Prasad
William Snyder

OTHER SFI FACULTY

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Martin Williams

DO YOU WORRY about pesticide residues on the fruit you buy in the supermarket? What about *E.coli* contamination in your favorite fast food? Do you know where *Salmonella* infections come from or how urban waste products affect the groundwater? Did you know that Washington is world renowned for its production of "club wheat"? Or that "beetle banks" may soon be used to help control agricultural pests? Sample, if you will, the buffet of topics currently under investigation by a large network of research and extension faculty participating in the WSU Safe Food Initiative.

THE WSU SAFE FOOD INITIATIVE

The WSU Safe Food Initiative (SFI) was created in 1999 when the Washington State Legislature appropriated $4.25 million in funding for a WSU Agricultural Research Center (ARC) and WSU Extension initiative. The initiative funds a variety of research and education positions in the College of Agricultural, Human and Natural Resource Sciences (CAHNRS), the College of Veterinary Medicine (CVM) and the College of Sciences. The funding also provides support for the Washington State Commission on Pesticide Registration to help develop alternatives to pesticide use. With permanent biennial funding at $7.5 million, the SFI specifically targets three areas emphasizing faculty teamwork:

- Ensuring the safe, efficient production of food for consumers and the marketplace.
- Improving controls of devastating pests, while minimizing environmental impacts.
- Protecting natural resources with economically viable food production systems.

Overall, many of the SFI research programs involve ways to transition traditional farming methods into more sustainable organic agricultural production. Much work is being done in the areas of environmental protection and integration, plant breeding and disease resistance as well as more effective control of zoonotic diseases, that is, animal diseases that are capable of infecting people. The following sections will touch on a few of the largest SFI objectives; however, they represent only a fraction of ongoing research projects and teams.

IMPROVING FOOD QUALITY AND SAFETY FOR DOMESTIC AND GLOBAL MARKETS

Internationally recognized for its outstanding wheat development program, WSU has recently taken further steps to diversify wheat varieties for the world market. To help assure the quality and marketability of every new variety of wheat bred at WSU, **Brady Carter** was hired under the SFI as a wheat quality specialist in the Department of Crop and Soil Sciences. Under Carter's leadership, the position developed into a well-established program that enhanced the overall wheat genetics and

breeding program. Carter has since taken a position in private industry and will now be succeeded by **Byung-Kee Baik**, former IMPACT cereal chemist and assistant professor from the Department of Food Science and Human Nutrition. Carter and Baik add their expertise to the established wheat development team of **Kim Kidwell**, associate professor and spring wheat breeder; **Stephen Jones**, associate professor and winter wheat breeder; and **Kulvinder Gill**, associate professor and wheat geneticist. All are in the Department of Crop and Soil Sciences.

In the past, breeders tended to focus on production of high yielding varieties, but today they try to balance yield with quality. For example, many of the recently developed types of wheat are bred specifically to provide high-end-use baking quality for breads, cookies, cakes and noodles. The first of nine new varieties recently bred at WSU was Zak, which was in high demand by the Nabisco Company in Portland, Oregon. Unfortunately, Zak turned out to be susceptible to a disease called "stripe rust," so it is now being phased out and replaced by a rust-resistant, high-yield variety called Louise with which Nabisco is also pleased.

According to Carter, there are seven market classes of wheat, each targeted for a specific use. The market classes are familiar to those who live on the Palouse: hard red winter and spring wheat, hard white winter and spring wheat, and soft white winter and spring wheat. There is a sub-class under soft white wheat known as club wheat which is specifically used for Asian sponge cakes. One of the newest club wheat cultivars, named Chukar, was developed at WSU. Washington is currently the only place in the world producing high quality club wheat. WSU has also released new varieties in each of the other classes except one—hard red winter wheat—though a variety is scheduled for release in February 2005.

Further research is underway to study the characteristics of wheat preferred by Asian markets with the goal of making U.S. wheat exports more competitive in these countries. Carter said the goals SFI set for his team are being fulfilled in conjunction with many other projects and extension work. He can see direct as well as indirect effects in the industry. Wheat growers have responded by recognizing poor quality varieties and subsequently restricting their production while supporting the research and new varieties that the WSU wheat development team is bringing to the forefront. "All of this helps increase the economic benefits and marketability of our Washington wheat crop," he said.

PROTECTING FOOD CROPS FROM DEVASTATING PESTS

Scientists may come up with countless methods to increase crop productivity, but it would all be for naught if the bugs had their way. Insects, weeds and plant diseases would decimate food crops if not for scrupulous use of biocontrols or chemical interventions. Throughout the Washington State University system, studies are underway to discover new types of biological pest controls including organic farming techniques as well the use of newer, less toxic pesticides, which target specific pests without killing beneficial insects.

William Snyder, biocontrol specialist in the WSU Department of Entomology, is deeply involved in this type of work under the SFI, focusing on "conservation biological control" for both conventional and organic farms. This method makes use

of the natural enemies of crop pests already living in the fields. For example, Snyder and his team, led by Ph.D. student **Renee Prasad**, have developed a way to help conserve predatory insects by putting in a "beetle bank." This entails leaving a strip of grass across a field that is never tilled or sprayed with pesticides, thereby serving as a stable bug refuge. Nocturnal ground beetles, which eat other insects, then have a safe place to avoid harvesting, squishing and poisoning as well as vegetation in which to overwinter and hibernate. This strategy is predicted to work well for both organic and conventional farms.

Snyder was also among those selected for a 2004 ARC grant to continue and expand his research begun under the SFI. He is quick to credit interdisciplinary teamwork for the success of his projects. Several of these team efforts involve Washington's No. 3 cash crop, potatoes, with annual production worth over $450 million. In the Northwest, potato pests have been traditionally eradicated by the systematic spraying of broad-spectrum insecticides, as often as every 10 days. In a statewide study, Snyder is focusing on new, more sustainable ways to control three of the most devastating insects: the Colorado potato beetle, flea beetles and wireworms.

The research builds on the premise that one way to move away from the use of chemical insecticides would be to apply diseases (usually fungi and/or pest-eating worms)—called "entomopathogens"—to kill crop pests instead. It has been shown that, in many cases, entomopathogenic worms can be applied in combination with selective insecticides which may ease the way to greater grower compliance. Entomopathogens also have the ability to build up in the soil and "recycle" themselves from year to year, thereby potentially saving producers thousands of dollars in pesticide applications. Another strategy is to try using mustard cover crops, or "green manure," in winter fields—to help stabilize soil erosion as well as control potato pests.

Yet many questions remain to be answered. Will the entomopathogens also attack the beneficial insects? Will the mustard cover crops also harm the helpful worms? "Farmers are constantly managing all of these things at once," said Snyder. "In research we tend to focus on only one narrow subject, but we are becoming more holistic in our approach and the growers like this!" Snyder says the goal of this project is to achieve the use of entomopathic fungi and/or worms on 60 percent of organic acreage in the area as well as 10 percent of the conventional potato acreage. "We hope to provide growers with a more complete picture of the advantages and disadvantages of using biocontrol agents on their own and in combination with cover crops," said Snyder. "The complexity of organic or sustainable agricultural systems is definitely a challenge for the growers. But the potential benefits from restoring these agricultural systems to a more natural state are immense."

In conjunction with this study is one led by **Robert Gallagher**, assistant professor in the Department of Crop and Soil Sciences. Funded by the USDA, Gallagher is working on finding ways to help eastern Washington wheat farmers transition into organic farming. Since it takes three years to transition land from chemical-based to certified organic, the funding aims to find ways to help farmers avoid bankruptcy during the transition time. Initially, growing organic wheat will cost more, but it also brings a higher price on the market.

PROTECTING NATURAL RESOURCES WITH ECONOMICALLY VIABLE FOOD PRODUCTION SYSTEMS

Throughout the western United States, the topic of natural resource allocation is sure to elicit lively discussion. Battles reign between those vying for conservation versus those for industrial and economic development. In such an environment, the establishment of a successful small farm requires knowledge of not only agricultural and marketing strategies, but also range and watershed management together with programs for reducing soil erosion and animal waste (nitrate) contamination of ground and surface water.

The statewide Small Farms Program in western Washington, led by Director **Marcia Ostrom** in Puyallup, is a perfect illustration. The SFI had initially set aside funding for one faculty position in small farms, which was filled by Ostrom in 2001. Since that time, the Small Farms Program, which includes campus and county-based research and extension faculty, has managed to leverage its humble beginnings into a thriving statewide program. To date, the program has attracted over $1.3 million in federal and private funding.

The Small Farms Program works with communities to foster profitable family farms, land stewardship and access to healthy food. Through initial surveys and focus groups, farmer and community needs and interests were identified. In response, the Small Farms Program developed many new programs targeting high-priority areas such as the problems encountered by new and transitioning farmers. The Small Farms Program focuses its resources on four main objectives with the primary aim being farmer education and training in environmentally sound and economically profitable farming techniques. Community education, policy and marketing initiatives are also emphasized.

Part of this outreach includes offering courses on small-scale farming and sustainable agriculture at six WSU sites including Puyallup, Colville, Port Orchard, Port Angeles, Renton and Port Hadlock. "Become a small farm entrepreneur" tempts the heading for "Cultivating Success," an innovative course series offered in partnership with the University of Idaho and with Rural Roots, an Inland Northwest non-profit group that advocates strong farmer-consumer connections. The program combines classroom and on-farm learning experiences targeting new and existing farmers, college students, and agricultural professionals. Studies include courses on agricultural entrepreneurship, whole farm business planning, marketing and ecologically-based livestock and crop production. Field days, workshops, and conferences as well as numerous research and demonstration sites add to the learning experience. Courses are currently being modified to help reach Latino and newly immigrated East Asian farmers, two of the fastest-growing segments of the farming population.

According to Ostrom, nearly 300 students have taken the courses so far—with 85 of those effectively completing business plans for running a profitable small farm. Many have already gone on to develop successful farming enterprises which not only boost Washington state economy, but improve food quality as well.

Much of the Small Farm Program is dedicated to sustainable organic cultivation. Six acres of land at WSU-Puyallup have been designated for organic certification and

are being used for research, education and training for environmentally sustainable farmers. Research is also underway to determine how to incorporate urban waste, such as wastewater and yard clippings, into farming. The goal is to help urban centers and farmers work together to recycle the nutrients in waste products instead of just sending them into streams and oceans.

ZRU FACULTY

Dale Hancock - Co PI
Tom Besser – Co PI
Monica Borucki
Doug Call
Rowland Cobbold
Larry Fox
Clive Gay
John Gay
Frank Loge

ZOONOSIS RESEARCH UNIT

Of vital concern in today's public health arena are the diagnosis, treatment and prevention of zoonotic infectious diseases—or those animal diseases capable of infecting humans. Exotic diseases, once contained by geography, may now, with the aid of a mobile society, find easy passage to our collective back yards. The transmission of West Nile virus to people, for example, or the threat of a pandemic avian influenza outbreak are realities demanding urgent investigation.

Traditionally, zoonoses have been an area of study and service in the WSU College of Veterinary Medicine (CVM) within the Agricultural Animal Health Program (AAHP). Over the years, the CVM has operated its Field Disease Investigation Unit (FDIU) in collaboration with the Agricultural Research Center (ARC), a part of the College of Agricultural, Human and Natural Resource Sciences (CAHNRS). This working arrangement, which involved faculty taking joint appointments and salaries in both colleges, led to a body of compiled research on food safety. Based on this groundwork, the idea arose in 1995 to create an integrated agricultural animal health program in the CVM. The original goal, to maximize efficient use of scarce resources, led to the idea of looking at disease control from the basic science lab to its practical application in the field. What has evolved is a major multidimensional program designed to solve long-standing as well as emergent health problems of both people and animals.

A crucial step in this evolution was the decision to hire clusters of faculty members who shared similar research interests in complementary areas of expertise. The early success of these collaborations contributed greatly to the 1999 funding of the WSU Safe Food Initiative by the Washington State Legislature as well as the $9.9 million National Institutes of Health grant awarded to WSU in 2003. The NIH grant led directly to the creation of the Zoonosis Research Unit, in the CVM, which will help serve as front-line defense in the prevention of diseases including bovine spongiform encephalopathy or mad cow disease.

The story began in 2000, when **Doug Call** and **Chris Davies**, assistant professors in the Department of Veterinary Microbiology and Pathology, together with **Rowland Cobbold**, assistant professor in the FDIU, were hired as a faculty cluster under the SFI to investigate issues of disease control and food safety. Call and Cobbold have been specifically working on ways to identify and control current and emerging livestock diseases in order to help assure a quality product to the world market.

For example, much of their work focuses on ways to contain the ever-present *E.coli 0157* (the culprit in the early 1980s Jack in the Box outbreak), *Salmonella* and *Listeria* bacteria in cattle. One goal is to develop a reliable test to distinguish between species specific strains of *E. coli 0157*—since it is difficult to tell whether the bacteria came from cows or people.

Studies are also underway to discover how *Salmonella Newport*, a significant cause of livestock loss in the Pacific Northwest, is spread and why it persists in the environment. One reason bacteria such as *Salmonella* and *Listeria* are so resilient is due to their production of biofilms—a sort of micro-slime layer that is all but impossible to remove from infected surfaces, including stainless steel.

Antibiotic resistance is another critical problem for the livestock industry, even on organic farms where no antibiotics have been given. New assays to help understand the on-farm dynamics of this problem are in progress.

This team effort, including collaborators in the AAHP, bore great results, garnering the $9.9 million, seven-year NIH grant which led to the establishment of the Zoonosis Research Unit (ZRU) whose mission is to investigate specific food- and water-borne zoonotic diseases in Washington State.

The goals of the ZRU are three fold. The first includes proposals for the study of zoonotic agents such as *Salmonella, E.coli* and *Listeria* infections; antibiotic resistance; and the transmission of agents through surface irrigation water. The second goal is to develop an emergency response plan for dealing with the possibility of extraordinary zoonotic events like the threat of bioterrorism or massive national outbreak of a disease such as avian flu. Third, the ZRU seeks to collaborate with other Washington state agencies such as the Public Health Laboratory and the Department of Ecology for ongoing surveillance of emerging diseases.

The ZRU research group, led by **Dale Hancock,** professor in the FDIU, and **Tom Besser,** professor in Veterinary Microbiology and Pathology and Coordinator of Public Health Services in the Washington Animal Disease Diagnostic Laboratory (WADDL), was further honored to be included in the newly established National Food- and Water-borne Diseases Integrated Research Network. The Network is an elite group of 5 units located throughout the nation that collaborate and integrate zoonotic research findings. "There will be much collaboration between units within the CVM and across campus," said Hancock. "It will include working with our colleagues in the College of Agricultural, Human and Natural Resources Sciences, the Department of Civil and Environmental Engineering, and the USDA Animal Disease Research Unit."

Though the ZRU projects are still in the initial stages of development, Doug Call has been designated PI for the surveillance of emerging zoonoses and Dale Hancock is PI for the study of dissemination of pathogens by surface water. The virulence of *Listeria monocytogenes* is under investigation in projects under the direction of **Monica Borucki** as PI. There has been tentative approval for a study on the regional dissemination of *Salmonella*, under the leadership of **Rowland Cobbold.**

Of recent zoonotic concern was the diagnosis of the nation's first case of bovine spongiform encephalopathy (BSE) or mad cow disease in Washington State in December 2003. Since then, several attempts to pass new legislation to bolster mad cow research have met with mixed results. According to **Terry McElwain,** Executive Director of WADDL and Director of the Animal Health Research Center, the Senate Joint Memorial Bill, which asks the federal government to support BSE research in Washington state has passed the legislature and been forwarded

to federal agencies for consideration. On the other hand, the USDA has recently chosen the WSU CVM to be one of seven laboratories nationwide authorized to conduct BSE surveillance using a high throughput, rapid testing method. WADDL began testing June 1, 2004, and currently averages approximately 100 tests daily. The samples come from Washington as well as surrounding states. The initial program will run 12 – 18 months with the results shaping the future of BSE testing and surveillance at WSU.