2010 Washington State University Research Annual Report of Accomplishments and Results

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I. Report Overview

1. Executive Summary

This was both a challenging and a productive year for the scientists in the Washington State University (WSU) Agricultural Research Center (ARC), the Agriculture Experiment Station of Washington State University. The ARC faculty and staff as a group increased their external support obtained from various federal sources, state sources, crop commissions, industry, etc. over 50%, to $42.8 million but lost the crown as a top external funding group in the College of Agricultural, Human and Natural Resource Sciences (CAHNRS) to Extension, which had excellent success with AARA related programs. The aggregate was almost half of the total WSU external support. The research-related funds cover work in a myriad of subject areas and the individual projects approach the work from a variety of perspectives. Washington state agriculture is more diverse than that of many other states, partly as the result of the different climate and soil conditions found in the state, partly because of its emphasis on meeting agricultural needs of both domestic and export markets. This report outlines a few of our major successes and documents the adaptation of the ARC and CAHNRS in response to constraints and opportunities.

The most significant of the constraints has been a decreased state budget. On top of a net cut of about 9% in 2009, we took additional cuts of about 8% in 2010. Although research was spared a larger cut by the use of funds generated through tuition increases, justification made by CAHNRS that researchers are important in the WSU teaching missions is likely to mean that over the long term our faculty will have a larger fraction of their appointments in instruction. We finished the elimination of the Department of Community and Rural Sociology in July, 2010, and decreased allocations of resources to selected programs within CAHNRS. As a consequence of previous cuts and administrative realignments, WSU Extension was moved back into CAHNRS in 2009 and the integration of Research and Extension is continuing. A recent summary of the current financial situation can be found at http://cahnrs.wsu.edu/fs/budget/perfect-storm.ppt. As of Spring, 2011, we are expecting cuts to WSU of over 20% of the state allocation, about half of which may be offset by tuition increases. How much of this cut will be taken from CAHNRS and the ARC is pending but, because to the depth of earlier cuts, we expect the impacts to be both significant and structural. These cuts will clearly impact research also supported using formula funds.

Researchers on the Pullman campus, at the WSU Research and Extension Centers and at field locations throughout Washington State are engaged in over 300 projects that address the needs of Washingtonians and the nation. Our goal is to develop and leverage basic science to ensure that our farms and industries can compete in the global economy with quality products, to protect the security of our food production, processing and distribution systems, to keep our population healthy and well nourished, to protect our natural resources and environment, and to enhance economic opportunity for individuals, businesses, and communities. Our work is of high quality; WSU was listed among the top 25 schools in the world on the basis of citation impact in agricultural science by Science Watch newsletters and various plant and animal science WSU programs based primarily in CAHNRS were highly ranked in a 2007 survey published in the Chronicle for Higher Education.

Grants obtained during the year included several from the 2010 USDA Specialty Crop Research Initiative, including major awards as part of grants targeted at onion and wine grape pathology problems and awards through the state WSDA allocation that support work in flower and nursery tree management and IPM management. Because the SCRI competitions are structured to favor projects with substantial industry support and well integrated Research and Extension activities, we take this funding as evidence

that we have research programs that are directed toward the needs of our stakeholders, at least in these areas of production agriculture. This has been especially rewarding to the tree fruit industry, which has invested heavily in the development of increased capabilities in Horticulture over the last several years. Three notable grants were obtained from NIH, in stem cell manipulation in cattle, development of wheat that lacks the epitopes that cause celiac disease and in using transcription analysis to elucidate the pathways plants use to synthesize medicinally significant compounds. Large awards were also obtained from NSF in wheat genetics through the BREAD program, in fatty acid and plant oil biosynthesis and in secondary compound metabolism in plants that make rhizoid structures. Significant programs were also funded in organic agriculture and sustainable agriculture. Another area where WSU is poised to make substantial progress is in storm runoff, where various agencies have combined to fund research in new remediation efforts at the Puyallup R&E Center, and in animal waste lagoon management. Some of these awards involved major roles by new faculty, including assistant professors, showing that, despite the dramatic decrease in new faculty hires, we continue to do well in the slots we are filling.

Washington State has been a leader in developing practices to support sustainable agriculture, including low erosion cultivation techniques, ways to minimize pesticide and herbicide use, and breeding for disease and pest resistance. The state has also been innovative in supporting scientific research in organic production techniques and in implementing value added marketing based on organic and limited input production systems. While some of this work has been carried out under the umbrella of the Center for Sustainable Agriculture and Natural Resources, much of it is integrated into our routine research goals. An example of this is the WSU Decision Aids system for making real time integrated pest management decisions for the tree fruit industries that is based on an expert system model developed by our scientists that integrates weather and other local data with insect growth rate and pesticide properties to advise whether or when to apply materials (http://entomology.tfrec.wsu.edu/das/). A major accomplishment in this area was the hiring of a new Director for the AgWeatherNet, who brings outstanding capabilities to a system already recognized as one of the best in the world. One test of our capabilities in predictive IPM is on the horizon, with the sighting of the spotted wing Drosophila in Washington State and our participation in a major grant to develop strategies for dealing with this pest, which can oviposit on intact developing fruit, like berries and cherries, making it a potential threat to major local industries.

Researchers have adapted their programs to focus more on aspects of biofuels, biomass, and bioproducts research of particular relevance to the state. These include projects to add value to straw and other waste products, to improve the yield and stability of crops like poplars that have been identified as a potential energy crops well suited to this region and produce useful materials from various waste streams associated with food and fiber production. Our contributions to bioenergy are likely to be in areas like pyrolysis of mixed lignocellulose feedstocks or anaerobic fermentation, which are foci WSU Center for Bioproducts and Bioenergy. In addition to the scientists now being recruited to the Center in Richland, considerable expertise exists at the main campus in Pullman. Another focus has been in the generation of higher value biofuels, such as those needed for aircraft. These fuels must be more energy dense than ethanol and their generation from plant materials will require plants to produce more lipids, terpenes and phenylpropanoids, areas of metabolism that are represented by strong programs in the Institute of Biological Chemistry. The Composite Materials Engineering laboratory is studying how to use carbohydrate and polyalkanoate biopolymers in fabricating plastics and coatings.

The buildings being constructed on the WSU main campus and at field stations contribute to the excitement in research. The Vogel Plant Biosciences Building was opened in 2007. Funded by the state legislature, the 93,000 square foot, four story structure is located next to several older buildings in the CAHNRS precinct of the WSU Pullman campus and it contains many facilities, like climate controlled rooms and high tech laboratories, which were difficult to install in the older buildings. Space in Vogel was allocated by the need for these new facilities and not by departmental unit and there has been a secondary but important effect of mixing faculty from different areas. Vogel is the first of a planned complex of seven interconnected buildings devoted to the Life Sciences. A second building opened in summer, 2009, and houses the School of Molecular Biosciences from the College of Sciences. A new building being constructed adjacent to this will house some of the more basic science oriented research programs in the Animal Science department and link these more closely to similar programs in animal physiology

administered through the College of Veterinary Medicine.

The reports in the Planned Program areas reflect an overview of some of the activities in 2010. However, the reporting vehicle is not well suited to describing major changes in the Plan of Work for these areas and the Program directors were advised to try to make the configuration of the report reflect the current situation rather than simply to fill in the boxes. In particular, this affects the Program in Food Science, which is merging with the Food Science department at the University of Idaho located just across the state border. This integrated department found a new chair in 2010 and helps resolve an uncertain situation described in earlier reports.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	479.9	0.0
Actual	0.0	0.0	446.2	0.0

II. Merit Review Process

1. The Merit Review Process that was Employed for this year

- Internal University Panel
- External University Panel
- Expert Peer Review
- Other (individual external peer reviewers from within or without the university)

2. Brief Explanation

In 2008, CAHNRS participated in the university-wide Academic Affairs Program Prioritization process. While this activity focused primarily on graduate and undergraduate education, these are linked through the participation of our researchers in student training. This A2P2 process was used as a context for the budget cuts implemented in 2009 and 2010 and the recommendations from this process were re-examined in detail to yield the final budgeting priorities. The overall result of these processes was a serious examination of all departments and programs and included examination of their research priorities and capabilities.

Agricultural Research Center (ARC) project proposals are written by individual faculty members or faculty teams and these proposals are submitted first to their department chairs. The department chair reviews the submission and ascertains whether the topic of the research is consistent with departmental and College goals and, if so, sends the project proposal to internal and/or external reviewers. These reviewers are asked whether the research represents solid science, is directed to topics of current interest, will advance the field of study, and whether the research plan is appropriate. Reviewers are invited to offer written suggestions for improvement and asked to identify the strongest and weakest points of the proposal. After comments are received from the reviewers, the chair assembles the commentary and submits it to the faculty member. If necessary, the faculty member then revises the project proposal. After examining these changes, the Chair submits the project proposal to the Agricultural Research Center where it is reviewed by either the Director or the Associate Director. After this review, the proposal is sent to USDA CSREES and reviewed by the appropriate National Program Leader. When approval is final, the approved project is entered into our database and into the CRIS system. In parallel, proposals for funding that may overlap these projects may be submitted to federal or state agencies or to commodity

commissions. These proposals are reviewed and input, especially from the commissions, is often used in refocusing and in setting future research directions.

III. Stakeholder Input

1. Actions taken to seek stakeholder input that encouraged their participation

- Targeted invitation to traditional stakeholder groups
- Targeted invitation to non-traditional stakeholder groups
- Targeted invitation to traditional stakeholder individuals
- Targeted invitation to non-traditional stakeholder individuals

Brief explanation.

Stakeholders in Washington recognize WSU as a major asset for their industries and are often very forthcoming with suggestions and critiques. We have web pages, our phone numbers are in plain sight and our stakeholders are used to giving both formal and informal input to the administrators and scientists in the ARC. One major mechanism of interaction is through various State commodity commissions, which support research at WSU through competitive processes that tend to be biased toward projects that address relatively immediate problems. In addition to researchers, the ARC Director or his representative is often present at these sessions to help the groups understand the context of the research and to get their input into the strategic planning done at WSU related to their industry. Stakeholder input is also received by the use of various advisory committees to advise departments, centers, and programs. There is a College level advisory committee as well as a college level agricultural kitchen cabinet. Both of these interact with the dean, the experiment station director, and other associate deans helping to define priorities, identify emerging research issues, and provide feedback on the quality and relevance of our research activities. In what has been perceived as a crisis of funding, some of the stakeholders are responding by trying to increase their support of ARC programs through informational outreach and direct support (see for example http://www.treefruitresearch.com/).

2(A). A brief statement of the process that was used by the recipient institution to identify individuals and groups stakeholders and to collect input from them

1. Method to identify individuals and groups

- Use Advisory Committees
- Use Internal Focus Groups
- Use External Focus Groups
- Open Listening Sessions
- Needs Assessments

Brief explanation.

Established industries tend to have formal bodies that we have worked with through the years and many of our interactions with these industries are through these constituent groups. The situation is more complex in interacting with emerging groups, particularly if these are not organized with a component that includes research support. Often the contacts with these groups are made through specific issues, like carrying out the research to certify a pesticide for a minor crop, dealing with a land use issue that is peculiar to their industry, or determining methods that can be used locally to establish sustainable production. Much of what is done in these cases is to identify what

capabilities we have that can be useful and in trying to develop a plan to obtain or allocate resources. For various reasons, the ARC has relatively little funding or personnel that can be redirected rapidly so, especially for minor crops, it is important to see areas where resources can be shared through coalition building, often with other stakeholders or other universities. One consequence of the increased share of the ARC budget as external grant support and decreased share supported by funds that can be reallocated internally is that it is likely to become more difficult to respond to critical needs that develop quickly since there is less funding that can be reassigned internally. Stakeholders therefore are likely to be asked to identify both their needs and the resources that they can bring to the effort.

2(B). A brief statement of the process that was used by the recipient institution to identify individuals and groups who are stakeholders and to collect input from them

1. Methods for collecting Stakeholder Input

- Meeting with traditional Stakeholder groups
- Meeting with traditional Stakeholder individuals
- Meeting specifically with non-traditional groups
- Meeting specifically with non-traditional individuals
- Meeting with invited selected individuals from the general public

Brief explanation.

We go to meetings. We answer phones and we read email. We listen. Established industries tend to have formal bodies that we have worked with through the years and many of our interactions with these industries are through these constituent groups. It is more complex to interact with emerging groups, particularly if these are not organized with a component that includes research support. Contacts with these groups are often made through specific issues, like carrying out the research to certify a pesticide for a minor crop, dealing with a land use or production issue that is peculiar to their industry, or determining methods that can be used locally to establish sustainable production. In these cases we try to identify capabilities we have that might be useful and often try to develop a plan to obtain, allocate or reallocate resources. The ARC has relatively little funding or personnel that can be rapidly redirected so, especially for minor crops, it is important to see areas where resources can be shared through coalition building, often with other stakeholders or other universities. As a State institution, we also have stakeholders referred to us by the legislature or by State and county executives.

3. A statement of how the input will be considered

- In the Budget Process
- To Identify Emerging Issues
- Redirect Research Programs
- In the Staff Hiring Process
- In the Action Plans
- To Set Priorities

Brief explanation.

Input from stakeholders enters our research programs at several levels. Through direct funding decisions and the participation of the ARC administrators or their delegates in the funding process, we see stakeholders state their priorities and often allocate their own money to research at WSU and elsewhere. Sometimes a project may be structured to separate objectives that are more

easily supported by the ARC from those that are supported by the stakeholders. The ARC takes stakeholder prioritization into account in allocating resources, such as space or faculty and technical positions, and we communicate our limitations to groups that often are better placed to obtain additional resources. As a State group, we are charged with responding to those who look to us for help but this is increasingly limited by the resources we are being allocated. In 2007, we began an internal grants program to direct resources toward Emerging Issues in Agriculture (http://arc.wsu.edu/info/eri/index.html). The priorities of this program were articulated with stakeholder input and stakeholders participate in the review process. In addition to the research accomplishments of the teams, the team building and preliminary data generated through this process were able to leverage considerable outside funding. This kind of project expansion pleased the stakeholders but unfortunately the formal program has been limited in 2010 by the need to use reources in other ways.

Brief Explanation of what you learned from your Stakeholders

The overwhelming message is that stakeholders want more help in research and its applications. Especially because Washington State agriculture is so diverse and has so many minor crops, the research capability at WSU can be a key to bringing new crops to profitability under local conditions. Historically, this has meant breeding more productive wheat varieties, developing methods for controlled atmosphere storage, choosing wine cultivars suited to particular sites, and developing procedures for organic and sustainable agriculture. Conflict can arise when this broad need meets the limited resources available. Specifically with regard to programs like SCRI, our stakeholders whose industries were able to obtain funding through the SCRI matching mechanism were pleased with the growth of their investment in research. There are two other categories of stakeholders, those who invest in research but did not receive substantial leverage and those who do not invest much in research. The first is pressuring our researchers to do better,; the second may be considering more research investment because they now see themselves at a competitive disadvantage. However, we are not seeing a rush of new groups to invest in our research, although support from our traditional constituencies has remained strong.

IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)			
Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	3872378	0

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	0	0	3500849	0
Actual Matching	0	0	2911234	0
Actual All Other	0	0	52681450	0
Total Actual Expended	0	0	59093533	0

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous				
Carryover	0	0	146052	0

V. Planned Program Table of Content

S. No.	PROGRAM NAME
1	Program in Food Science
2	Program in Animal Science
3	Western Regional Plant Introduction Station (W-006)
4	Program in Plant Pathology
5	Program in Economic Sciences
6	Program in Statistics
7	Program in Community and Rural Sociology
8	Program in Agricultural Animal Health
9	Program in Fruit and Vegetable Development, Production and Management
10	Program in the Post Harvest Quality of Fruits and Vegetables
11	Program in Environmental Horticulture
12	Program in Entomology
13	Program in Natural Resource Sciences
14	Wood Materials Engineering Laboratory
15	Program in Biological Systems Engineering
16	Institute of Biological Chemistry
17	Program in Crop Genetics and Breeding
18	Program in Sustainable Crop and Soil Managment
19	Global Food Security and Hunger
20	Climate Change
21	Sustainable Energy
22	Childhood Obesity
23	Food Safety

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Program in Food Science

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
501	New and Improved Food Processing Technologies			25%	
502	New and Improved Food Products			14%	
503	Quality Maintenance in Storing and Marketing Food Products			11%	
702	Requirements and Function of Nutrients and Other Food Components			10%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins			40%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	13.0	0.0
Actual	0.0	0.0	21.8	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	35911	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	35911	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	2338187	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

In recent years, the cost of production and competition from international players in conventional agricultural commodities has increased. Washington producers, because of logistics, cost of production and increasing environmental and regulatory requirements, are becoming less competitive in many commodity markets. The School of Food Science is providing scientific and technical information that will assist producers and processors to develop profitable new foods and new markets for healthy foods. Health promoting functional foods will include foods that can reduce the risk of cancer and provide healthy food choices. Furthermore, the College of Agricultural, Human and Natural Resources Sciences is poised to provide this assistance to the state agricultural community by building upon existing strengths within the College regarding the production, processing and utilization of a variety of important food products as well as in the area of sustainable organic agriculture and consumer education. The presence will bolster community outreach aspects of the food science program.

2. Brief description of the target audience

Food producers, processors, packers, peers, professionals, industry, and consumers

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	3610	4100	160	80

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2010

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	10	59	69

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer reviewed journal publications

Year	Actual
2010	59

Output #2

Output Measure

- Graduate students supported by experiment station funding and grants

Year	Actual
2010	13

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Investigation of rapid detection systems for food contamination.
2	Investigation of novel food processing and storage methods
3	Scientists and companies would use the information we have published to further their research and food production practices
4	Rapid detection systems move to a pilot plant testing phase.
5	Information in published research is incorporated into production practices thus improving the safety of the food supply.
6	Novel rapid detection methods for food pathogens become available to the food and processing industries improving the safety of the food supply

Outcome #1

1. Outcome Measures

Investigation of rapid detection systems for food contamination.

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Investigation of novel food processing and storage methods

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	4	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The food industry to improve food quality and safety.

What has been done
In a partnership with faculty in Biosystems Engineering, thermal and nonthermal technologies were evaluated for improving food quality of selected processed foods while keeping them safe for consumption. In general, food engineers focus on the process while food scientists evaluate the effect of the new process on food quality and safety. In thermal processing, the study of microwave (MW) technology continued by comparing the advantages of this process with the conventional thermal treatment for processing salmon and mashed potatoes. The microwave sterilization process developed at WSU received formal approval by the U.S. Food and Drug Administration using salmon as the test product. Meanwhile in the area of nonthermal technologies, Pulsed Electric Fields (PEF) was explored in depth while testing milk, milk products, and grape juice. The microbial inactivation/activation of selected microorganisms (including spores) received specific attention. Some changes in other components of these food products (color and flavor) and possible changes in the electrode of the system were also investigated. Studies were also conducted using high hydrostatic pressure (HHP) in some milk and flavored milk and ultrasound (US) in dairy products such as yogurt and milk, as well in some selected

juices such as orange and peach.

Results
Improve safety and quality of products for the consumer. Improve energy efficiency of food processes.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
502	New and Improved Food Products

Outcome #3

1. Outcome Measures

Scientists and companies would use the information we have published to further their research and food production practices

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	12	10

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Improving the safety and quality of food.

What has been done
WNP716. Control of foodborne pathogens in pre- and post-harvest environments. Research provided unique and valuable insights on the relationship between indicator organism levels and pathogen risk throughout a farm environment, including irrigation water, composting, and crop systems. These results were communicated to growers and led to specific recommendations regarding farming practices, including composting, and irrigation methods. Research to identify antimicrobial compounds to reduce pathogen risk in organic leafy greens production systems was initiated. A peroxyacetic acid rinse was found to have antimicrobial activity when used during fresh, whole apple packing. Lactic acid was an effective alternative to chlorine during mobile poultry slaughter. Interest from meat processors in three states was received regarding use of the lactic acid rinse.

Results
These results were communicated to growers and led to specific recommendations regarding farming practices, including composting, and irrigation methods. Interest from meat processors in three states was received regarding use of the lactic acid rinse.

4. Associated Knowledge Areas

KA Code	Knowledge Area
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #4

1. Outcome Measures

Rapid detection systems move to a pilot plant testing phase.

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Information in published research is incorporated into production practices thus improving the safety of the food supply.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	1	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The food industry in Washington State, the US and all consumers.

What has been done
Training in Hazard Analysis Critical Control Points, safe quality foods, food sanitation, and Good Agricultural Practices (GAP's). Research on food microbiology is included into these programs.

Results
Safer food production which translates to a safe food supply for consumers. Changes in food handling and packaging processes in the industry to prevent foodborne illness.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #6

1. Outcome Measures

Novel rapid detection methods for food pathogens become available to the food and processing industries improving the safety of the food supply

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

In addition to external factors commented on elsewhere, an issue directly related to the Food Science program was the delays that budget constraints in both Idaho and Washington caused in recruting a new chair for the joint bi-state department. This recruitmant was successful in 2010 and should make it more feasible to articulate the capabilities and direction to be taken in the future.

V(I). Planned Program (Evaluation Studies and Data Collection)

Evaluation Results

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Program in Animal Science

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
133	Pollution Prevention and Mitigation			5%	
301	Reproductive Performance of Animals			25%	
302	Nutrient Utilization in Animals			15%	
303	Genetic Improvement of Animals			5%	
304	Animal Genome			10%	
305	Animal Physiological Processes			10%	
307	Animal Management Systems			5%	
308	Improved Animal Products (Before Harvest)			10%	
311	Animal Diseases			5%	
701	Nutrient Composition of Food			5%	
722	Zoonotic Diseases and Parasites Affecting Humans			5%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	5.0	0.0	14.0	0.0
Actual	0.0	0.0	20.2	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
0	0	166685	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	135081	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	2337401	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

We have: (1) evaluated nutritional, physiological, and genetic mechanisms for differences in the use of dietary energy for growth, lactation, and animal maintenance, (2) evaluated sources of feedstuffs, and methods of processing for enhanced rumen function, and productivity in animals, (3) searched for candidate genes and DNA markers for improved quality and yield of meat in beef cattle, (4) searched for candidate genes and DNA markers for enhanced reproduction and nutrient utilization in dairy and beef cattle and for susceptibility or tolerance to animal disease, (5) developed new approaches and investigated the molecular and biological regulation of germ and somatic cells in mammalian spermatogenesis, (6) defined the underlying mechanisms responsible for the hormonal regulation of somatic tissue growth and development in rainbow trout and other species. (7) developed mathematical models to better understand and evaluate factors related to metabolism in the lactating dairy cow, (8) obtained gaseous and particulate emissions data from cattle feedlots and provide credible scientific information for making air quality policy.

2. Brief description of the target audience

In general, the target audience for the program includes consumers of food products produced by the livestock industry. However, the pathway of information from our research program includes commercial and seed stock producers in the dairy, beef, swine and sheep industries. It also includes companies that produce feeds, pharmaceuticals, and consulting to these industries.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	2500	5000	1300	2500

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2010

Actual: 4

Patents listed
Patent US 7,662,564 B2
Patent US 7,666,599 B2
Patent US 7,790,383 B2
Patent US 7,662,567 B2

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	6	33	39

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer reviewed journal articles

Year	Actual
2010	33

Output #2

Output Measure

- Graduate Students supported by Agricultural Research Center and other grant funds

Year	Actual
2010	7

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Enhanced understanding of nutrient utilization and mechanisms of nutrient use by animals.
2	Enhanced food quality, food safety, consumer acceptance of foods from animal sources and issues of animal and human health.
3	Identification of strategies to decrease the environmental footprint from livestock systems.
4	Enhanced reproductive efficiency of livestock.
5	Enhanced understanding of mechanisms associated with growth and differentiation of muscle cells and adipocytes.

Outcome #1

1. Outcome Measures

Enhanced understanding of nutrient utilization and mechanisms of nutrient use by animals.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	3	5

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Identifying ways to increase the efficiency of nutrient utilization will enhance the sustainability of livestock operations from financial and environmental perspectives. Thus, projects contributing new information to understanding genetic links associated with nutrient use in animals are valued by the animal production and allied industries. Work in this area is also currently supported by external competitive grants.

What has been done
Projects are implementing techniques to study metabolic activity and regulation at the subcellular level. As an example, gene expression techniques are being used to study lipolysis and lipogenesis in lactating cows and mitochondrial energy expenditures in beef cattle at various stages of production.

Results
Refereed journal articles, presentations at international conferences, graduate student training and USDA / CAP grant proposals.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
303	Genetic Improvement of Animals
701	Nutrient Composition of Food

Outcome #2

1. Outcome Measures

Enhanced food quality, food safety, consumer acceptance of foods from animal sources and issues of animal and human health.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	11	21

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Projects are of immediate importance to consumers and producers as they impact food safety, food quality, animal behavior, and well being, and animal and human health issues. Results are used and valued by commercial beef industry, by leaders in livestock production using genomic technologies for breeding and selection decisions, and by consumers making informed decisions about the quality and safety of the meat they consume. External support for this work further identifies its relevance to industry.

What has been done
Methodology to quantify fatty acids associated with meat quality has been developed and is currently evaluated for commercial applications. Identification of genetic markers that are associated with meat quality traits and animal health are being investigated. Factors impacting animal responses to production and management techniques are evaluated.

Results
17 Refereed publications, 4 patent applications, graduate student training, CAP grant proposals submitted, hosted regional research committee meetings (NC 1029), presentations at national and international conferences.

4. Associated Knowledge Areas

KA Code	Knowledge Area
303	Genetic Improvement of Animals
304	Animal Genome
307	Animal Management Systems
308	Improved Animal Products (Before Harvest)

311 Animal Diseases

Outcome #3

1. Outcome Measures

Identification of strategies to decrease the environmental footprint from livestock systems.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	3	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The ability to quantify and monitor inputs and outputs of livestock systems is essential for sustainable production. The impact of livestock systems on water and air quality are being addressed in several projects having direct impact on the production systems as well as social impact to the community. Projects are also supported with competitive external federal funds. An NSF-IGERT grant focusing on nitrogen has resulted in multidisciplinary expansion of efforts and graduate student training.

What has been done
Novel techniques to measure emissions from livestock units have been developed and results are being used in establishing federal and international regulatory guidelines. Precision feeding strategies have been designed to meet animal nutrient requirements while minimizing excretion of minerals. Education tools available to mass audiences nationally are being developed to aid producers in whole farm nutrient balance practices.

Results
Refereed publications, input to state and national policies, integrated extension and research efforts, graduate training.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
302	Nutrient Utilization in Animals
303	Genetic Improvement of Animals

307 Animal Management Systems

Outcome #4

1. Outcome Measures

Enhanced reproductive efficiency of livestock.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	2	5

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Reproductive performance and efficiency has many impacts on sustainable livestock production. Projects are designed to identify stimulating factors and mechanisms associated with both male and female germ cell differentiation. Impacts of this work may influence the breeding practices and reproductive performance in livestock operations and also have applications to human health. This work is also funded by external grants and industry support.

What has been done
Bovine testis xenografts have been successfully used to identify factors stimulating germ cell differentiation. In vitro culture requirements for porcine and bovine uterine and testicular fibroblasts were identified and will provide necessary information for future work. A new faculty member studying early pregnancy recognition and implantation has received external grant support and peer reviewed publications adding new strength to this area.

Results
Refereed publications, graduate training, invited presentations,

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
303	Genetic Improvement of Animals
304	Animal Genome

Outcome #5

1. Outcome Measures

Enhanced understanding of mechanisms associated with growth and differentiation of muscle cells and adipocytes.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	4	13

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Endocrine control and cellular mechanisms regulating growth of muscle and adipose cells provide important new information relevant to animals and humans. One project is designed to study the role of myostatin in regulating muscle growth in rainbow trout. Another project studies the regulation and differentiation of adipocytes in the study of fat accretion in domestic species. Projects in this area have potential to make important contributions to human growth and development as well. Work in this project area is also supported with external competitive grants and industry support.

What has been done
Mechanisms of action and regulation have been identified leading to more complete understanding of muscle growth and development and adipogenesis.

Results
13 peer reviewed publications, graduate training

4. Associated Knowledge Areas

KA Code	Knowledge Area
305	Animal Physiological Processes

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities

Brief Explanation

Budget issues, especially those that relate to reduced state support for WSU, created significant uncertainties. Ultimately, these relate to competing public priorities and the place that the research mission of Animal Sciences has in the state and university. We appear to be integrating two recent hires and have been authorized to move forward in filling an endowed chair, which was partly the result of external gifts.

V(I). Planned Program (Evaluation Studies and Data Collection)

Evaluation Results

Key Items of Evaluation

In October, 2008, the department was reviewd by an external CSREES team. Two of the departments goals addressed by the external review included solidifying our position as a department recognized as an important contributor in selected areas to the national and international research agenda and teaching arena.

The review team agreed that a key component in the department's future success is to continue to work towards the target of 25 faculty members in the department. Discussion of establishing or maintaining faculty critical mass and areas of emphasis was addressed throughout the CSREES review and continues to be a priority for the department. We currently have 18 tenure track faculty but a long term hiring plan is in place. In 2009, 2 faculty (Pru, Capper) joined the department. The Baxter Endowed Chair for Beef Research will be in place in May, 2011 and another funded chair position in Animal Sciences in the muscle biology area will be filled in Aug, 2011.

Review committee recommendations suggested that a long term plan and strategy to modernize our facilities needed to be articulated and defined with sufficient detail to convey our needs to college and university administrations, engaged stakeholders and other interested parties. Dairy farm renovation planning has stalled in the last year due to unexpectedly high estimates and budget constraints at all levels. Some research laboratory facilities will be upgraded by 2012-13 when Animal Sciences will occupy a portion of a new, state of the art, research-intensive, laboratory-based facility to house selected research programs with biomedical application potential.
We believe that the external review provided valuable input and helped us focus our needs and priorities to position the department for a successful future. We will continue working to implement additional recommendations as the situation and resources allow.

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Western Regional Plant Introduction Station (W-006)

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
201	Plant Genome, Genetics, and Genetic Mechanisms			10%	
202	Plant Genetic Resources			55%	
206	Basic Plant Biology			10%	
211	Insects, Mites, and Other Arthropods Affecting Plants			10%	
212	Pathogens and Nematodes Affecting Plants			10%	
215	Biological Control of Pests Affecting Plants			5%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	3.5	0.0
Actual	0.0	0.0	5.1	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	525803	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	47732	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	4047	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

This project promotes utilization of a wide array of plant genetic resources for grower, processor and consumer stakeholders, and safeguards the genetic resources for the future generation. This project is one of the four initial Regional Plant Introduction Stations established in the 1950s. In terms of numbers of populations managed, the fiscal, personnel, and facility resources utilized and the genetic diversity addressed, it is one of the most important components of the NPGS. As of February 8, 2011, there are 87,356 accessions. During the calendar year of 2010, we shipped out 22,212 packets of seed samples to 983 requesters from 46 countries worldwide. Our priorities have been preserving these important resources, making them available to researchers, and collecting as much evaluation data as possible for individual accessions. Project research, information documentation and germplasm conservation relate directly to all aspects of the USDA, ARS National Program Action Plan. We also provide communication platform to promote the utilization of plant germplasm by researchers in the Western Region, particularly scientists associated with the SAES Universities. Plant germplasm resources are being utilized in the region to support crop development, help to sustain small farm agriculture, preserve endangered species, and to improve revegetation of the public land in the Great Basin. They are also used to develop new U.S. crops, and encourage international trading diplomacy through exchange of plant germplasm. From 2007, WRPIS distributes over 20,000 seeds samples each year to requesters from both public and private sectors and approximately one-third of these samples (varying from 5,000 to 7,000 each year) went to the Western Region. Researchers in the Western Region also request a large number of needed plant germplasm from other NPGS sites.

2. Brief description of the target audience

The target audience for this program is plant researchers.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	900	2000	50	150

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2010

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total

Actual	0	14	14

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer reviewed journal articles

Year	Actual
2010	14

Output #2

Output Measure

- Graduate students supported on Agricultural Research Center or other grant funds

Year	Actual
2010	1

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Completion and publication of our work in peer reviewed journals
2	Continued distribution of valuable germplasm and information
3	Development of valuable germplasm
4	Continued distribution of valuable germplasm
5	Development of new collaborative projects with state federal and international research scientists
6	Continued provision of quality germplasm of the species maintained at the Pullman site and delivered to researchers worldwide
7	Basic and applied research resulting from the sharing of germplasm--production of genetic maps, analyses of diversity, new medicinal plants, ornamentals,etc.
8	Restoration and re-patriotization of germplasm to seed banks in countries of origin. [This is difficult to predict.]

Outcome #1

1. Outcome Measures

Completion and publication of our work in peer reviewed journals

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	10	10

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
206	Basic Plant Biology
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
215	Biological Control of Pests Affecting Plants

Outcome #2

1. Outcome Measures

Continued distribution of valuable germplasm and information

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	18000	78000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
206	Basic Plant Biology
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
215	Biological Control of Pests Affecting Plants

Outcome #3

1. Outcome Measures

Development of valuable germplasm

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	1	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
215	Biological Control of Pests Affecting Plants

Outcome #4

1. Outcome Measures

Continued distribution of valuable germplasm

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	18000	200

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
202	Plant Genetic Resources
215	Biological Control of Pests Affecting Plants

Outcome #5

1. Outcome Measures

Development of new collaborative projects with state federal and international research scientists

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	3	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
206	Basic Plant Biology
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
215	Biological Control of Pests Affecting Plants

Outcome #6

1. Outcome Measures

Continued provision of quality germplasm of the species maintained at the Pullman site and delivered to researchers worldwide

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	18000	20000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
215	Biological Control of Pests Affecting Plants

Outcome #7

1. Outcome Measures

Basic and applied research resulting from the sharing of germplasm--production of genetic maps, analyses of diversity, new medicinal plants, ornamentals,etc.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	12	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources

Outcome #8

1. Outcome Measures

Restoration and re-patriotization of germplasm to seed banks in countries of origin. [This is difficult to predict.]

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities

Brief Explanation

The major factor that will hinder or limit the success of this program is the reduction of fiscal resources. This is dependent on the political environment over which we have no control. Environmental concerns are annual, in that there is a significant portion of the

program that is done in the field, but these are constraints that are and always have been dealt with each year. This project supports (15%) a larger USDA-ARS program that does not have sufficient operation money, but the coordination and collaboration with the SAES is critical to the continued success and productivity of the entire effort.

V(I). Planned Program (Evaluation Studies and Data Collection)

Evaluation Results

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Program in Plant Pathology

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
201	Plant Genome, Genetics, and Genetic Mechanisms			1%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants			1%	
206	Basic Plant Biology			1%	
212	Pathogens and Nematodes Affecting Plants			87%	
216	Integrated Pest Management Systems			10%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	67.8	0.0
Actual	0.0	0.0	69.9	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	316933	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	296263	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	7471424	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research and extension activities included preparing grant proposals, designing and carrying out experiments to address basic and applied aspects in plant pathology. These experiments were conducted in laboratories, greenhouses, and in field plots. Results of these studies were summarized, and analyzed statistically, and disseminated to producers in the state, to the lay public, and to other scientists in the discipline and in other disciplines through oral presentations at meetings, field plot tours, extension bulletins, scientific publications, newsletters, and electronically through websites. Peer-reviewed scientific papers, popular press articles, and book chapters were published. Data was provided to support registration of crop protection chemicals. Graduate students were trained to conduct and disseminate research.

2. Brief description of the target audience

Targeted audience: 1) Primary producers of and dealers involved with trade of agricultural, forestry, horticultural, seed, and nursery commodities produced in the state; Homeowners and policy makers with need for plant health information; and 2) other scientists conducting related research. Extension specialists and teachers involved in transmitting information to the public and students.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2010

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	26	54	80

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer reviewed journal articles

Year	Actual
2010	54

Output #2

Output Measure

- Graduate students supported by experiment station funds

Year	Actual
2010	39

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Increased number and quality of publications
2	Increased graduate student enrollment
3	Reduced Fungicide Use

Outcome #1

1. Outcome Measures

Increased number and quality of publications

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	61	54

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The total number of publications was lower in 2010 compared to 2009, party due to reduction in the faculty size (following resignation by one faculty member). Publications per research FTE continued to increase. The number of publications in high impact journals in the plant pathology discipline continued to increase. Faculty are increasingly publishing original research papers and invited review articles in leading journals in the discipline.

What has been done

Results
The number of publications in high impact journals in the plant pathology discipline continued to increase. Faculty are increasingly publishing original research papers and invited review articles in leading journals in the discipline.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
206	Basic Plant Biology
212	Pathogens and Nematodes Affecting Plants
216	Integrated Pest Management Systems

Outcome #2

1. Outcome Measures

Increased graduate student enrollment

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	29	39

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Increased graduate student enrollment. Enrollment as of fall 2010 stands at 46 (PhD to MS 2:1), one of the largest plant pathology graduate programs in the country

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
206	Basic Plant Biology
212	Pathogens and Nematodes Affecting Plants
216	Integrated Pest Management Systems

Outcome #3

1. Outcome Measures

Reduced Fungicide Use

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Competing Public priorities

Brief Explanation

V(I). Planned Program (Evaluation Studies and Data Collection)

Evaluation Results

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 5

1. Name of the Planned Program

Program in Economic Sciences

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
601	Economics of Agricultural Production and Farm Management			15%	
602	Business Management, Finance, and Taxation			5%	
603	Market Economics			15%	
604	Marketing and Distribution Practices			10%	
605	Natural Resource and Environmental Economics			15%	
606	International Trade and Development			10%	
607	Consumer Economics			10%	
609	Economic Theory and Methods			5%	
610	Domestic Policy Analysis			10%	
901	Program and Project Design, and Statistics			5%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	21.4	0.0
Actual	0.0	0.0	19.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
0	0	111353	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	95901	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	2524794	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

The expected outputs from this research take a number of different forms. One form is the publication of high quality peer reviewed publications, which will validate the scientific merit of the research performed under this project, and will stand as long term contributions to the inventory of knowledge in the respective areas of inquiry. It is also expected that a number of research bulletins, research grant reports, and both peer-reviewed and invited presentations disseminating the results of the research will be delivered to appropriate clientele by faculty analysts themselves. In addition to outreach efforts by research faculty, which is an expectation of all faculty in the School of Economic Sciences, the research results will also be translated into an outreach and engagement effort through collaboration with Extension faculty, and timely and relevant deliverables in this regard will include Extension bulletins, workshops, downloadable data, tables, and reports, and other outreach and engagement activities with appropriate clientele. It is expected that the knowledge disseminated through the aforementioned mechanisms to appropriate decisions makers in various segments of the agricultural sector, government, and general society will generate an informed decision environment and will contribute sufficient insights into the economic and societal consequences of decisions so that actual decisions made will enhance the sustainability of the agricultural sector, balance the need for uses and preservation of natural resources, and further good stewardship of the environment.

2. Brief description of the target audience

The target audience of the School of Economic Sciences includes decision makers in various segments of the agricultural sector, government and the general society. Our work will also influence economists in academia nationally and internationally.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	1356	1464	2	5

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2010
Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	20	23	43

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer reviewed journal articles

Year	Actual
2010	24

Output #2

Output Measure

- Graduate students supported by experiment station and grant funds

Year	Actual
2010	34

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number and Quality/reputation of refereed journal publications (mid-tier field/economics journals and above.
2	Number and quality of other research bulletins, reports and presentations at major conferences.
3	Degree of contribution of fundamental knowledge within the fields researched (percent increase).
4	Number and value of external grants in support of the research program (units are dollars).
5	Contribution to improved/new research methods/tools (percent of output).
6	Relevant knowledge generated for use by policy and decision makers (percent of output).
7	Number of graduate students trained and placed in the job market.
8	Degree to which overall research funding is increased (percent).
9	Number of additional institutionally funded and externally funded GRAs that are studying and researching in the School.

Outcome #1

1. Outcome Measures

Number and Quality/reputation of refereed journal publications (mid-tier field/economics journals and above.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	24	23

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Addresses a variety of priority issues relating to the indicated USDA knowledge areas and that were also listed previously as being addressed as part of SES's Research Program.

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
603	Market Economics
605	Natural Resource and Environmental Economics
606	International Trade and Development
607	Consumer Economics
609	Economic Theory and Methods
610	Domestic Policy Analysis
901	Program and Project Design, and Statistics

Outcome #2

1. Outcome Measures

Number and quality of other research bulletins, reports and presentations at major conferences.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	30	20

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Addresses a variety of priority issues relating to the indicated USDA knowledge areas and that were also listed previously as being addressed as part of SES's Research Program.

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
603	Market Economics
605	Natural Resource and Environmental Economics
606	International Trade and Development
607	Consumer Economics
609	Economic Theory and Methods
610	Domestic Policy Analysis
901	Program and Project Design, and Statistics

Outcome #3

1. Outcome Measures

Degree of contribution of fundamental knowledge within the fields researched (percent increase).

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	5	5

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
This represents the estimated proportion of published and presented research output generated by faculty that contributes to the advancement of economic theory for use in applied economic research.

What has been done
Contributions to the economic theory-based conceptualizations of models of economic behavior that underlay analyses of consumer, producer, and agribusiness decision making.

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
603	Market Economics
605	Natural Resource and Environmental Economics
606	International Trade and Development
607	Consumer Economics
609	Economic Theory and Methods
610	Domestic Policy Analysis
901	Program and Project Design, and Statistics

Outcome #4

1. Outcome Measures

Number and value of external grants in support of the research program (units are dollars).

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	1100000	1900000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
This represents the amount of new extramural funding for which faculty have been associated as either a PI, Co-PI, or collaborator.

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
603	Market Economics
605	Natural Resource and Environmental Economics
606	International Trade and Development
607	Consumer Economics
609	Economic Theory and Methods
610	Domestic Policy Analysis
901	Program and Project Design, and Statistics

Outcome #5

1. Outcome Measures

Contribution to improved/new research methods/tools (percent of output).

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	5	5

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
This represents the estimated proportion of published and presented research output generated by faculty that contributes to the advancement of statistical/econometric theory and methods for use in applied quantitative economic research.

What has been done
Research on new or improved statistical and econometric methods that underlie quantitative economic analyses of consumer, producer, and agribusiness decision making was completed, and papers on the results were presented and published.

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
603	Market Economics
605	Natural Resource and Environmental Economics
606	International Trade and Development
607	Consumer Economics
609	Economic Theory and Methods
610	Domestic Policy Analysis
901	Program and Project Design, and Statistics

Outcome #6

1. Outcome Measures

Relevant knowledge generated for use by policy and decision makers (percent of output).

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	10	18

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
This represents the estimated proportion of published and presented research output generated by faculty that addresses priority issues in the Agricultural and Natural Resource sectors and that contributes to informing policy and decision makers as to the benefits, costs, societal welfare, and overall economic consequences of decision outcomes.

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
603	Market Economics
605	Natural Resource and Environmental Economics
606	International Trade and Development
607	Consumer Economics
609	Economic Theory and Methods
610	Domestic Policy Analysis
901	Program and Project Design, and Statistics

Outcome #7

1. Outcome Measures

Number of graduate students trained and placed in the job market.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	14	8

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
This represents the number of PhD (8) students who have successfully completed the graduate program and who have been placed in positions relevant to their training.

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
603	Market Economics
605	Natural Resource and Environmental Economics
606	International Trade and Development
607	Consumer Economics
609	Economic Theory and Methods
610	Domestic Policy Analysis
901	Program and Project Design, and Statistics

Outcome #8

1. Outcome Measures

Degree to which overall research funding is increased (percent).

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	10	50

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Substantial increase in the amount of research funding has been derived from increased success in securing extramural funding by the program's faculty. However we experienced significant reduction in research operations funding from the state.

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
603	Market Economics
605	Natural Resource and Environmental Economics
606	International Trade and Development
607	Consumer Economics
609	Economic Theory and Methods
610	Domestic Policy Analysis
901	Program and Project Design, and Statistics

Outcome #9

1. Outcome Measures

Number of additional institutionally funded and externally funded GRAs that are studying and researching in the School.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	2	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Unable to fund additional grad students due to the timing of the progress of existing graduate students to graduation.

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
603	Market Economics
605	Natural Resource and Environmental Economics
606	International Trade and Development
607	Consumer Economics
609	Economic Theory and Methods
610	Domestic Policy Analysis
901	Program and Project Design, and Statistics

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

There has been some reduction in the number of faculty in the School whose principal research focus is on traditional agricultural sector issues. Because of an unprecedented number of faculty retirements, there has also been a substantial demographic change in the unit, with more than half of the faculty being assistant professors and on the faculty for 3.5 years or less. These factors combined to exert a notable negative influence on the overall research productivity of the unit in critical areas relevant to the types of output produced and tracked in this report.

V(I). Planned Program (Evaluation Studies and Data Collection)

Evaluation Results

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 6

1. Name of the Planned Program

Program in Statistics

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
901	Program and Project Design, and Statistics			100%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.3	0.0	0.8	0.0
Actual	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	0	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	0	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

We are not reporting on this program as it has been transferred to another unit due to economic cut backs and Hatch program suppport was removed.

2. Brief description of the target audience

The target audience is other academic statisticians, biologists and scientists of other disciplines who are consumers of knowledge.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2010

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	0	1	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer reviewed publications

Year	Actual
2010	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Immediate dissemination of knowledge gained from research projects through talks presented and peer reviewed publications
2	Number of peer reviewed journal and proceedings papers, number of talks given.
3	Implementation of statistical methodologies and procedures derived from individual research projects in our department by other scientists.
4	Number of citations for articles published which are based on individual research projects.

Outcome #1

1. **Outcome Measures**

Immediate dissemination of knowledge gained from research projects through talks presented and peer reviewed publications

Not Reporting on this Outcome Measure

Outcome #2

1. **Outcome Measures**

Number of peer reviewed journal and proceedings papers, number of talks given.

Not Reporting on this Outcome Measure

Outcome #3

1. **Outcome Measures**

Implementation of statistical methodologies and procedures derived from individual research projects in our department by other scientists.

Not Reporting on this Outcome Measure

Outcome #4

1. **Outcome Measures**

Number of citations for articles published which are based on individual research projects.

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Other (See below)

Brief Explanation

The Program in Statistics was jointly administered by this unit and the College of Sciences until mid 2009, when it was transferred completely to the College of Sciences. We no longer consider it to be a Planned Program under the Agricultural Research Center at WSU.

V(I). Planned Program (Evaluation Studies and Data Collection)

Evaluation Results

Not applicable

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 7

1. Name of the Planned Program

Program in Community and Rural Sociology

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
803	Sociological and Technological Change Affecting Individuals, Families, and Communities			100%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	2.4	0.0
Actual	0.0	0.0	2.4	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	26977	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	21297	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	192199	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

We are not reporting on this program as the department that housed it was eliminated due to budget cut backs.

2. Brief description of the target audience

The target audience includes other social scientists, persons interested in sustainable agriculture, communities, agri-businesses, demographers and policy makers.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2010

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	6	8	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer reviewed journal articles

Year	Actual
2010	0

Output #2

Output Measure

- Graduate students supported by Agricultural Research Center funds including grants

Year	Actual
2010	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Steady increase in the number of state residents accessing bulletins and other stakeholder directed publications via the department website.
2	Steady increase in number of state residents accessing survey results via the department website.

Outcome #1

1. **Outcome Measures**

Steady increase in the number of state residents accessing bulletins and other stakeholder directed publications via the department website.

Not Reporting on this Outcome Measure

Outcome #2

1. **Outcome Measures**

Steady increase in number of state residents accessing survey results via the department website.

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Public Policy changes
- Competing Public priorities

Brief Explanation

The Program in Community and Rural Sociology was eliminated due to budget cuts.

V(I). Planned Program (Evaluation Studies and Data Collection)

Evaluation Results

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 8

1. Name of the Planned Program

Program in Agricultural Animal Health

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
307	Animal Management Systems			2%	
308	Improved Animal Products (Before Harvest)			10%	
311	Animal Diseases			30%	
312	External Parasites and Pests of Animals			2%	
313	Internal Parasites in Animals			2%	
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals			2%	
403	Waste Disposal, Recycling, and Reuse			20%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources			2%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins			20%	
722	Zoonotic Diseases and Parasites Affecting Humans			10%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	2.0	0.0
Actual	0.0	0.0	2.4	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
0	0	0	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	0	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	346068	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

The following areas of emphasis for the Planned Program have been worked on this year: We investigated the epidemiology and ecology of Salmonella enterica in and around farms. The ultimate goal is to develop strategies to prevent entry of infection to the farm and to mitigate zoonotic risk. Through molecular epidemiology, we determined the antibiotic resistance elements of microbes associated with livestock, either as commensally associated flora or disease agents. We conducted bovine mastitis research to identify transmission factors for Staphylococcus aureus and Mycoplasma spp, the epidemiology, and immune responses to these agents. We developed milk tests to better diagnose these mastitis agents and improve mastitis prevention management. We determined the role of common anaerobic digester systems for dairy waste nutrients in the dissemination of disease agents between farms. Information will be disseminated in the form of manuscripts in research journals, lay press, and extension bulletins.

2. Brief description of the target audience

Our target audience includes academicians, clinicians, microbiologists, public health authorities, practicing veterinarians, farmers, and the general public.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	160	0	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2010

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	4	10	14

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer reviewed journal articles

Year	Actual
2010	10

Output #2

Output Measure

- Graduate students supported on agricultural research center funds and grants

Year	Actual
2010	8

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Define natural occurance and shedding patterns of E. coli O157:H7
2	Determine the extent of Salmonella typhimurium DT 104 as an emerging and zoonotic pathogen
3	Develop PCR test for mycoplasma mastitis in milk samples
4	Assess Epidemiology of mycoplasma mastitis
5	Research support in dollars for the project on E. coli O157:H7
6	Determine the Role of the Coagulase Negative Staphylococci in causing Mastitis.

Outcome #1

1. Outcome Measures

Define natural occurance and shedding patterns of E. coli O157:H7

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	1	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Dairy producers, livestock veterinarians, and the consuming public should be concerned on how bovine waste nutrient products are processed on the farm. Anaerobic digestion of cattle excrement has the potential to minimize wastage and make a 'cleaner' product. Yet the question of whether their is transfer of potential enteric disease agents between farms when the anaerobic digestion product is transferred back to the farm needs to be addressed to minimize the potential risk of human and cattle safety.

What has been done
Analysis of potential enteric pathogens: commensal generic E. coli, E. coli O157:H7, generic Enterococcus, Salmonella, Mycobacteria avium subspecies paratuberculosis, Camplylobacter, and Listeria, have been evaluated.

Results
Commensal generic E. coli, E. coli O157:H7, generic Enterococcus, Salmonella, Mycobacteria avium subspecies paratuberculosis, Camplylobacter, and Listeria preliminary analyses suggest a reduction of 2.49 logs and generic E. coli are reduced 1.14 logs by the AD process. Also, the AD process does not appear to be differentially selective, meaning that measures like organism bioprofiles and antibiotic resistance profiles and proportions do not appear to be altered by the AD process.

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems
308	Improved Animal Products (Before Harvest)

311	Animal Diseases
403	Waste Disposal, Recycling, and Reuse
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #2

1. Outcome Measures

Determine the extent of Salmonella typhimurium DT 104 as an emerging and zoonotic pathogen

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	1	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Public consuming cattle products should be concerned as a new clade of S. typhinmurium has been found to affect both humans and bovines.

What has been done
Multiple locus variable number tandem repeat analysis and plasmid profiling of Salmonella isolates.

Results
A mechanism of acquisition of expanded spectrum cephalosporin resistance in this clade was reported. Multiple locus variable number tandem repeat analysis and plasmid profiling suggest that resistance was acquired by multiple independent genetic events within the clade. We suspect that selection pressure arising from the use of ceftiofur in cattle is a factor involved in the increased cephalosporin resistance.

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems
308	Improved Animal Products (Before Harvest)

311	Animal Diseases
403	Waste Disposal, Recycling, and Reuse
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
722	Zoonotic Diseases and Parasites Affecting Humans

Outcome #3

1. Outcome Measures

Develop PCR test for mycoplasma mastitis in milk samples

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	1	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Producers, dairy practitioners and milk consuming public. Mastitis is the most costly agricultural disease with more than 1 billion dollars lost in discarded milk, culling of cattle and lost milk production associated with the disease complex. Although small, a risk of zoonotic transmission of pathogens exists.

What has been done
The hypothesis that was tested was that 16S rRNA gene sequencing (16S) performed on DNA from quarter milk samples of cows with clinical mastitis (CM) would identify the same bacteria found by aerobic milk culture. To test this hypothesis duplicate milk samples were collected from cows with CM. Aerobic milk culture was performed on 100 mL of milk for presumptive bacterial identification and cfu/ml determination. Only data from cows with the same milk culture result on duplicate milk samples (n= 31) were included.

Results
Common mastitis pathogens were cultured from 24 samples and 7 were bacteriologically negative (BN). DNA was harvested from each 2 mL milk sample and quantitated. A variable region of the small ribosomal subunit gene was amplified using PCR primers complementary to flanking regions shared among eubacteria. and cloned. Sequences of 12 clones from each sample were determined and GenBank searches used to identify bacterial species with the most similar

sequences (>99% identity). For 18 of 24 (75%) samples, 16S results agreed with culture results. These samples all had >250 cfu/mL (median 13,650; range 290 to > 30,000 cfu/mL) bacteria on culture and >40ng/mL of DNA (median 444; range 45.4 to 1730 ng/mL). In contrast, the remaining 6 samples had lower bacterial counts (median 40 cfu/mL; range 10 to 520) and lower DNA yields (median 44 ng/mL; range 0.70 to 756). In 4/6 samples where culture and 16S results differed, culture identified low numbers of coagulase negative staphylococci and no consistent clone was revealed by 16S.

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems
311	Animal Diseases
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #4

1. Outcome Measures

Assess Epidemiology of mycoplasma mastitis

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	0	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Dairy producers and livestock veterinarians. Mycoplasma mastitis is an emerging disease problem. A recent NAHMS report estimated that 20% of all large dairies (>500 cows) had an occurrence of this disease. A better understanding of the disease process might help reduce the spread of the disease and the loss of production, as well as increasing animal welfare.

What has been done
Studies on the epidemiology of mycoplasma mastitis on herds experiencing outbreaks.

Results

It was determined in a herd with an outbreak of Mycoplasma bovis diseases that cows already housed in a sick pen were approximately 100 fold more likely to contract this agent and develop clinical mastitis than cows in the home lactating pens. Transmission of the agent was hastened by the increased contact with infected animals accounting for the increased risk of disease in the sick or hospital pen. These findings suggest that the spread of the disease can increase with hospital pen effective contacts. Thus dairy managers and dairy practitioners must cautiously test both cattle entering and exiting the hospital pen.

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems
311	Animal Diseases
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #5

1. Outcome Measures

Research support in dollars for the project on E. coli O157:H7

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Determine the Role of the Coagulase Negative Staphylococci in causing Mastitis.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Dairy producers. Coagulase negative staphylococci are the primary cause of bovine mastitis, infecting approximately 20-50% of all cows. Although rarely a cause of clinical disease, this is a

heterogeneous group of pathogens and their intramammary infections will lead to a reduction in production and a change in milk composition.

What has been done
A new PCR technique identifying GAP gene differences between species of coagulase negative staphylococci has been developed and applied. This enabled the study of the association between enterotoxin production by the coagulase negative staphylococci and different species.

Results
Current results indicate the group of enterotoxin genes, seb, seln, and selq was the predominant superantigenic genotype and was found in Streptococcus chromogenes, S. xylosus, S. haemolyticus, S. sciuri subsp. carnaticus, S. simulans and S. succinus. However, no significant differences were observed in mean LSCC between presence and absence of SAg genes in CNS isolates.

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems
308	Improved Animal Products (Before Harvest)
311	Animal Diseases
403	Waste Disposal, Recycling, and Reuse
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
722	Zoonotic Diseases and Parasites Affecting Humans

V(H). Planned Program (External Factors)

External factors which affected outcomes
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

The major factors affecting the outcomes of the reported projects are producer cooperation and funding. The Agricultural Animal Health program has focused on studying important diseases in farms and flocks of the major livestock industries in Washington State. Thus the program is reliant on general cooperation from the livestock industries and from specific individual producers. Several years ago, the dairy industry, which is the largest livestock industry in the state, suspended its use of research funding from check off dollars to fund production problems. Additionally this program has traditionally relied on the Extension Service for help in identifying prospective cooperating producers. In Washington State, there is now less than 1 FTE in area and regional dairy extension--there

were seven agents 20 years ago. Additionally, there were 3 full time state agents but now only 1.1. This reduction in Extension staff has limited the ability to conduct cooperative research. This may be best demonstrated in the survey study of factors associated with time to clearance of mycoplasma mastitis. In this effort, we intended to enroll 36 herds in this year's study. Only 18 herds were willing to cooperate.

Whereas funding for the food safety projects has been strong, the funding for projects in the mastitis areas has been weak. Efforts to obtain additional funding to support mastitis research are ongoing. Although unsuccessful with 3 grant proposals involving cooperative research, one was to be a cooperative project between the Universities of Wisconsin, Connecticut, and Vermont, a second is a BARD proposal with Israel, a third a national Coordinated Agricultural Program grant, successful funding was obtained from the Washington State Dairy Products Commission.

V(I). Planned Program (Evaluation Studies and Data Collection)

Evaluation Results

The program is reviewed both at the level of the individual investigator and the program at annual review time. The program is also evaluated by both the College of Agricultural, Human and natural Resource Sciences and the College of Veterinary Medicine as part of their annual review process.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 9

1. Name of the Planned Program

Program in Fruit and Vegetable Development, Production and Management

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
201	Plant Genome, Genetics, and Genetic Mechanisms			8%	
202	Plant Genetic Resources			10%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants			13%	
204	Plant Product Quality and Utility (Preharvest)			28%	
205	Plant Management Systems			23%	
206	Basic Plant Biology			7%	
212	Pathogens and Nematodes Affecting Plants			3%	
216	Integrated Pest Management Systems			1%	
404	Instrumentation and Control Systems			4%	
601	Economics of Agricultural Production and Farm Management			1%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources			2%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	45.3	0.0
Actual	0.0	0.0	26.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
0	0	343832	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	343832	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	3328604	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Specific activities vary across a wide range, from molecular level inquiry to field based studies concerning the efficacy of horticultural production practices. These activities include: (1) basic research applying molecular biology, genetics, and biochemistry to the calcium/calmodulin-mediated signal network that influences plant response to environmental factors; (2) development of data mining tools and resources for genomics research on Rosaceae; (3) studies in fruit production and biology, with an emphasis on sustainability of fruit production systems; (4) breeding and genetic studies in apple, cherry, raspberry, and strawberry, including genomics approaches to identify functional genetic markers for crop improvement; (5) studies of the anatomy and structure of the grape berry during growth and development; (6) research that emphasizes the use of plant bioregulators for apple, pear, and sweet cherry; (7) studies related to the interaction of various environmental and production factors influencing yield and quality of potato tubers; (8) research focusing on environmental factors and management practices as they influence grape physiology; (9) studies of effects of deficit irrigation and partial root zone drying in apple, cherry, and grape; (10) research that focuses on understanding factors that cause skin disorders of apples; (11) evaluation of potato cultivars for introduction into the Washington potato industry; (12) studies focusing on practical means of achieving balanced cropping; (13) effects of new clonal rootstocks on scion productivity, growth, and fruit quality in cherry; (14) research focusing on novel management strategies for high density cherry production; (15) the potential for mechanical harvest of fresh-market quality, stemless sweet cherries; and (16) the development of automation, sensing, control, and information systems for precision agriculture. The outputs of these activities will include: patents, plant variety releases, scientific journal articles, conference publications and presentations, poster presentations, field day presentations, web sites, and knowledge about production and management practices that is passed along to users in other informal settings.

2. Brief description of the target audience

The audience for this program will be other scientists, economists, agribusiness, farmers, horticulturists and the tree fruit, small fruit, and potato industries.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	4045	50612	20	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2010

Actual: 3

Patents listed

Poovaiah B., L. Du. Poovaiah, B.W. and Du, L. Size and/or growth engineering by modulation of the interaction between calmodulin, and brassinosteroid biosynthetic enzymes and orthologs thereof. (Patent pending). submitted.

Poovaiah B. Poovaiah, B.W. and Du, L. Control of plant immunity using inducible promoter-driven anti-sense or RNAi construct of AtSR1 (2 patents pending ? cases A-1028 and A-1029)

Knowles N., L. Knowles. Enhancement of potato tuber sprouting inhibitors using various combinations of agents. submitted. Application for provisional patent filed September 2, 2010. Registration No. 45,922

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	15	53	68

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer reviewed journal articles

Year	Actual
2010	53

Output #2

Output Measure

- Variety Releases

Year	Actual
2010	5

Output #3

Output Measure

- Plant Patents

Year	Actual
2010	4

Output #4

Output Measure

- Number of graduate students supported by Agricultural Research Center and external funds

Year	Actual
2010	9

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	See below under Evaluation.

Outcome #1

1. Outcome Measures

See below under Evaluation.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

Breeding and development of potato varieties that are more efficient in nitrogen use (Pacific Northwest Potato Variety Development Program, PNWPVD) has reduced the use of nitrogen, resulting in less nitrate contamination of ground water. The potential economic savings to NW potato growers was estimated to be $1.3 million or $72 per acre in 2006. Varieties released by this collaborative program accounted for 26% and 32% of potato acreage in the Pacific Northwest and WA in 2007, respectively. Farm gate value of these new varieties in WA in 2007 is estimated to be $160,000,000. It is estimated that the potato varieties developed by the PNWPVD program have returned $39 for every dollar (research & institutional) invested.

Other researchers in this program have identified the process that causes sun burning in apples, and have developed a product that reduces this disorder significantly. This discovery has the potential to save fruit growers literally tens of millions of dollars annually. It is estimated that the patented apple sunburn protectant (RAYNOX?(r)) alone saved the industry several million dollars during the past three growing seasons. The invention of RainGard to aid in the protection of cherries from cracking/splitting is also expected to have tremendous positive economic impact on the industry.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources

203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
206	Basic Plant Biology

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

External factors not anticipated when the Plan of Work was written include severe budget decreases at the state level and the implementation at the federal level of the Specialty Crop Research Initiative. Several research programs have benefited from competitive funding through the SCRI mechanism, especially those related to tree fruit.

V(I). Planned Program (Evaluation Studies and Data Collection)

Evaluation Results

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 10

1. Name of the Planned Program

Program in the Post Harvest Quality of Fruits and Vegetables

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
201	Plant Genome, Genetics, and Genetic Mechanisms			10%	
202	Plant Genetic Resources			10%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants			10%	
204	Plant Product Quality and Utility (Preharvest)			10%	
205	Plant Management Systems			10%	
206	Basic Plant Biology			10%	
501	New and Improved Food Processing Technologies			10%	
502	New and Improved Food Products			10%	
503	Quality Maintenance in Storing and Marketing Food Products			10%	
701	Nutrient Composition of Food			10%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	15.0	0.0
Actual	0.0	0.0	9.4	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
0	0	60827	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	52541	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	1011844	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Specific activities and outputs vary across a wide range from molecular level inquiry to field and lab based studies related to postharvest handling, storage, and processing of horticultural crops. These activities include: basic research that focuses on the application of molecular biology, genetics and biochemistry related to the biological, chemical, and physiological mechanisms that explain postharvest phenomena in horticultural crops; studies directed at the identification of controlled atmosphere storage regimes for apples and other fruits; investigation of flavor chemistry in apples; studies of the post-harvest/processing quality attributes of potatoes in the Tri-State Variety trials; research to identify factors that affect storability and processing quality of potatoes; research to identify improved strategies for storage of seed potatoes; research focused on the mechanical harvest and subsequent handling and storage requirements in asparagus; studies that address the use of microwave-vacuum drying technology for fruits and vegetables; studies that focus on lenticel breakdown and fruit finish in apples; and research that focuses on crop management factors that affect postharvest fruit and vegetable quality.

2. Brief description of the target audience

The target audience will be scientists in the area of post harvest quality of fruits and vegetables, agribusiness, economists, and the participating vegetable and fruit industries (in particular the stone and pome fruit industries, and the potato industry).

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	991	1600	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2010

Actual: 1

Patents listed
Knowles N., L. Knowles. Enhancement of potato tuber sprouting inhibitors using various combinations of agents. submitted. Application for provisional patent filed September 2, 2010. Registration No. 45,922

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	1	26	27

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer reviewed journal articles

Year	Actual
2010	26

Output #2

Output Measure

- Graduate students supported on Agricultural Research Center and external funding

Year	Actual
2010	4

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Please see written paragraph under evaluation.

Outcome #1

1. Outcome Measures

Please see written paragraph under evaluation.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

Reversal of MCP-induced ripening inhibition in apples could potentially allow higher-quality fresh products to be available in the late storage season thus increasing international and domestic value of the Washington fresh apple crop. Studies described increase our knowledge of metabolic responses to the stress induced in the postharvest storage environment. Based on the results from the potato seed age studies, growers are altering the way in which they manage seed at the end of the growing season and throughout storage to maximize productive and economic value to commercial growers. Project findings have broadened the knowledge of stone fruit texture and its genetic control, for the benefit of the present industry as well as breeders and beneficiaries of future cultivars. Existing cultivars were characterized for their endoPG genotype to reveal underlying fruit type, resolve many ambiguous cases, and identify softening phenotypes controlled by genetic mechanisms other than endoPG allelic variation. This information is being exploited by industry, breeders, and researchers. The interaction of Stony hard with Freestone-Melting flesh is also better understood. The endoPG markers have proven valuable for identifying potentially useful functional genetic diversity in germplasm collections. The massive diversity detected for the endoPG gene in Prunus has important implications for fruit evolution and crop domestication in this genus, and represents much potential for genetic improvement of texture attributes in stone fruit.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms

202	Plant Genetic Resources
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
206	Basic Plant Biology
501	New and Improved Food Processing Technologies

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

Decreases in state funding have significantly impacted our flexibility and operations although they have not led to overall program cutbacks at least partly because of our success in new funding programs.

V(I). Planned Program (Evaluation Studies and Data Collection)

Evaluation Results

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 11

1. Name of the Planned Program

Program in Environmental Horticulture

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
124	Urban Forestry			10%	
134	Outdoor Recreation			10%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants			25%	
212	Pathogens and Nematodes Affecting Plants			25%	
724	Healthy Lifestyle			10%	
802	Human Development and Family Well-Being			5%	
804	Human Environmental Issues Concerning Apparel, Textiles, and Residential and Commercial Structures			5%	
903	Communication, Education, and Information Delivery			10%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	3.3	0.0
Actual	0.0	0.0	13.2	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
0	0	52825	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	52825	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	1642666	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Specific activities that are part of this program include: investigations of the effects of cultural practices on plant root health and the establishment of landscape plants, research focusing on the development of an understanding or environmental and cultural factors that affect water stress and cold hardiness in landscape plants, research focusing on the identification of superior ornamental landscape plants for urban environments, studies of the influence of human experience in the development of perceptions related to urban landscapes, and research aimed at developing further understanding of the relationships between physical environments and human behavior. The outputs of these activities will include: plant variety releases, scientific journal articles, conference publications and presentations, poster presentations, field day presentations, web sites, and knowledge about production and management practices that is passed along to users in other informal settings.

2. Brief description of the target audience

The target audience for this program consists of other scientists in the discipline, extension personnel, social scientists, landscape horticulture industry, and the consumer/gardener.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	1822	0	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2010

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	5	22	27

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer reviewed journal articles

Year	Actual
2010	19

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	See below under Evaluation.

Outcome #1

1. **Outcome Measures**

   See below under Evaluation.

   Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

V(I). Planned Program (Evaluation Studies and Data Collection)

Evaluation Results

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 12

1. Name of the Planned Program

Program in Entomology

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
121	Management of Range Resources			5%	
135	Aquatic and Terrestrial Wildlife			5%	
136	Conservation of Biological Diversity			15%	
211	Insects, Mites, and Other Arthropods Affecting Plants			20%	
215	Biological Control of Pests Affecting Plants			20%	
216	Integrated Pest Management Systems			15%	
304	Animal Genome			5%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources			15%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	56.6	0.0
Actual	0.0	0.0	43.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
0	0	364448	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	358910	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	5844875	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Both basic and applied research will be conducted. Results of research efforts will be disseminated through refereed publications, general interest publications, Extension outlets, and presentations at scientific, stakeholder, and general public venues. A minimal amount of infrastructure will be constructed and equipment will be purchased during the plan of work period. All programs will involve the training of graduate students. Specific activities will include or produce a better understanding of biological diversity of native and disturbed habitats in Washington and the greater Pacific Northwest. Specimens collected and prepared during studies will be deposited in the James Entomological Collection. Studies of native and exotic species of arthropods in order to evaluate their potential for the control of and impact upon non-native, rangeland weed species. Studies directed at the management of direct and indirect pests through traditional technologies. Studies of basic biological and ecological principles as they relate to the management of pest and beneficial arthropods. Development and implementation of biological control and integrated pest management strategies for the management of pest arthropods, especially insects. Genomic studies of primarily honey bees and parasitic wasps to better enhance their beneficial potentials. The development and implementation of methods that measure and monitor agricultural chemicals in the environment. The development of methods that test the toxicological effects of agricultural chemicals on non-target organisms.

2. Brief description of the target audience

Target audiences for our work in the Department of Entomology include scientists in various related disciplines, farmers, extension, agribusiness, public policy makers, legislators, government agencies, and the general public.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	7156	1600	1400	150

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2010
Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	30	39	69

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer reviewed journal articles

Year	Actual
2010	39

Output #2

Output Measure

- Graduate Students supported on Agricultural Research Center and other external funds

Year	Actual
2010	29

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Percent of holdings that are implementing changes to IPM based on research findings
2	Percent decrease in pesticide use

Outcome #1

1. Outcome Measures

Percent of holdings that are implementing changes to IPM based on research findings

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	70	80

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Growers and farmers are interested in implementing IPM to reduce input costs (labor and chemicals) and to improve crop quality and marketability (reduced chemical residues). Non-farm citizens are interested in the widespread adoption of IPM by growers and farmers to reduce pesticides in the environments, improve water and air quality and improve food safety.

What has been done
CAHNRS entomologists are working on developing and improving IPM methodology and implementation in a number of crop/animal production systems, including: tree fruits, potatoes, small grains, honey bees, small fruits, forage crops, grapes, hops, greenhouses, pulse crops and others.

Results
Widespread adoption in many systems. Some pests are no longer targets of chemical control, because biological control is effective at keeping numbers below an economic threshold, such as the cereal leaf beetle in small grains. Cancellation of some previously available pesticides (carbofuran, dimethoate, endosulfan) has greatly increased the participation in IPM in growing many WA crops.

4. Associated Knowledge Areas

KA Code	Knowledge Area
136	Conservation of Biological Diversity
211	Insects, Mites, and Other Arthropods Affecting Plants
215	Biological Control of Pests Affecting Plants
216	Integrated Pest Management Systems

304	Animal Genome
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources

Outcome #2

1. Outcome Measures

Percent decrease in pesticide use

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	11	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Growers and farmers are interested in implementing IPM to reduce input costs (labor and chemicals) and to improve crop quality and marketability (reduced chemical residues). Non-farm citizens are interested in the widespread adoption of IPM by growers and farmers to reduce pesticides in the environments, improve water and air quality and improve food safety.

What has been done
De novo development of IPM programs (e.g. poplars) or continuous refinement of IPM methodology based on applied research, as new pesticides become available (more specificity), old pesticides become unavailable (cancelled registration) an new effective tools become available (e.g. biocontrol agents).

Results
IPM approaches have led to complete elimination of traditional pesticide spraying for some pests in some crops. Examples include the poplar clearwing moth in polar production, where IPM was responsible for a change from 50,000 lbs of carbofuran and 8,000 lbs of endosulfan in 2005 to complete elimination of these sprays in favor of complete control using a pheromone based system. Similarly there has been a documented 80% reduction in the amount of pesticides used on wine grapes in WA between 1995-2005.

4. Associated Knowledge Areas

KA Code	Knowledge Area
136	Conservation of Biological Diversity

211	Insects, Mites, and Other Arthropods Affecting Plants
215	Biological Control of Pests Affecting Plants
216	Integrated Pest Management Systems
304	Animal Genome
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Programmatic Challenges

Brief Explanation

V(I). Planned Program (Evaluation Studies and Data Collection)

Evaluation Results

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 13

1. Name of the Planned Program

Program in Natural Resource Sciences

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
112	Watershed Protection and Management			20%	
121	Management of Range Resources			10%	
123	Management and Sustainability of Forest Resources			15%	
135	Aquatic and Terrestrial Wildlife			40%	
136	Conservation of Biological Diversity			15%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	6.0	0.0
Actual	0.0	0.0	12.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	129630	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	129630	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	1596592	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

In our research in the Department of Natural Resource Sciences we perform laboratory and field experiments. Data is collected and analyzed. Papers, books, book chapters, and reports are written. Presentations are given in local, national, and international venues. Graduate students and undergraduate students are mentored and trained. Curriculum is revised and developed.

2. Brief description of the target audience

Our target audience includes other researchers within and without the discipline of natural resource sciences including extension educators, persons in industry, economics, policy makers, and the general public.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	100	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2010

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	0	20	20

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer Reviewed Publications

Year	Actual
2010	20

Output #2

Output Measure

- Graduate students supported on experiment station and grant funds

Year	Actual
2010	23

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	graduate students and post-docs trained
2	Percent increase in research support
3	New personnel in research positions

Outcome #1

1. Outcome Measures

graduate students and post-docs trained

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	5	9

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Our graduates have been very successful in finding employment throughout the western United States and are in demand by state and federal agencies in particular.

What has been done
We continue to seek extramural funding to support our graduate program.

Results
Four Masters and 5 PhD students completed their degrees in 2010.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
121	Management of Range Resources
123	Management and Sustainability of Forest Resources
135	Aquatic and Terrestrial Wildlife
136	Conservation of Biological Diversity

Outcome #2

1. Outcome Measures

Percent increase in research support

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	10	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Industry, stakeholders, and natural resource researchers.

What has been done

Results
The department experiences a 50% reduction in its research operations budget not including salaries. This reduction was a direct result of the state dire financial situation.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
121	Management of Range Resources
123	Management and Sustainability of Forest Resources
135	Aquatic and Terrestrial Wildlife
136	Conservation of Biological Diversity

Outcome #3

1. Outcome Measures

New personnel in research positions

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	0	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
New personnel in research positions

What has been done

Results
A .5 faculty line was transferred into the department as a result of the dissolution of another unit.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
135	Aquatic and Terrestrial Wildlife
136	Conservation of Biological Diversity

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations

Brief Explanation

Due to the economy we were not allowed to hire any faculty and this has made it more difficult to procure extramural funds.

V(I). Planned Program (Evaluation Studies and Data Collection)

Evaluation Results

Each faculty member with a Hatch project included in this group is reviewed annually, first by the Department Chair and subsequently by the Dean and Directors of the College of Agricultural, Human and Natural Resource Sciences. Target Measures used include: (1) Number of refereed journal articles produced, (2) Quality of refereed journal articles produced, (3) Amount of extramural funding received from other sources in support of these research efforts and (4) the number of masters and doctoral students completing their degrees. Over the longer term, the chair considers the impact of the research on resource management decisions. Unfortunately, these evaluations typically occur several years after the completion of the research.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 14

1. Name of the Planned Program

Wood Materials Engineering Laboratory

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
511	New and Improved Non-Food Products and Processes			100%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	0.5	0.0
Actual	0.0	0.0	3.9	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	0	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	0	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	321447	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

For the past year, we have made a great effort to investigate various means for solving the problems that biopolyester materials encounter during processing and application and to develop novel approaches for high performance materials. The two commercially available biopolyesters, i.e., poly (lactic acid) (PLA) and polyhydroxyalkanoates) (PHAs), were both used in our study. Specifically, we have advanced the investigation in the following ways:

1. Development of PHA/bamboo fiber composite by investigating the reinforcing and toughening effects of bamboo fiber for PHBV. 2. Investigation of a novel PLA ternary blend system for high impact performance by studying the effects of blending temperature on reactive interfacial compatibilization and vulcanization of the rubber during compounding and studying tensile and impact properties of reactively compounded PLA ternary blends. 3. Development of a novel processing technique for soy protein concentrate (SPC) blends: a. Process SPC as plastic in blending with other thermoplastic polymers; b. Study effects of plasticization, shear and composition on plastic behavior of SPC during compounding; c. Study the effects of processing aids on rheological and mechanical properties and morphology; d. Study the different effects of water and glycerol on phase structure of PLA/SPC blends.

Three oral presentations of the results were given at: (1) Two presentations, one on processing technology of PLA/SPC blends and the other on PLA toughening, at the International Symposium on Polymers and the Environment: Emerging Technology and Science at the 2010 BioEnvironmental Polymer Society (BEPS) Annual Meeting (2) one presentation at American Institute of Chemical Engineer (AICHE) annual meeting. In addition, one poster was displayed at the BEPS meeting, and one poster was displayed at the 2010 Washington State University Academic Showcase.

2. Brief description of the target audience

U.S. corn growers will be the immediate beneficiaries of the investigation by finding new applications of PLA and PHAs in a market dominated by petroleum-based plastics, because both polymers are corn starch-based. This research will also result in new value-added applications for products from other sectors in the agricultural industry, such as soybean and forestry. The general public will benefit from the results, because the biobased polymers (PLA and PHAs) and natural polymers are environmentally friendly and renewable; and their products are biodegradable and compostable after use. In addition, the findings from this project will advance the knowledge base of bioplastics and stimulate future developments within the biobased plastic materials industry.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	150	3000	2	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2010

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	0	8	8

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer Reviewed journal Articles

Year	Actual
2010	8

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Methods to improve the compatibility of natural fiber and biopolyesters and melt strength of biocomposities, knowledge of composition-morphology-property relationships of composites
2	Microcellular foaming extrusion process design and processing optimization of biocomposites; characterization of composition-morphology-property relationships of microcellular foam
3	Product application development of microcellular foaming technology of biocomposites

Outcome #1

1. Outcome Measures

Methods to improve the compatibility of natural fiber and biopolyesters and melt strength of biocomposities, knowledge of composition-morphology-property relationships of composites

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
This finding may provide important guidance in design and materials selection of biocomposites when high impact is required

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
511	New and Improved Non-Food Products and Processes

Outcome #2

1. Outcome Measures

Microcellular foaming extrusion process design and processing optimization of biocomposites; characterization of composition-morphology-property relationships of microcellular foam

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
PLA blended with rubber containing epoxy functional groups and an ionomer containing zinc ions to improve brittleness (high tensile toughness & high impact toughness).

What has been done

Results
The brittleness of poly(lactic acid) (PLA) is a major obstacle for its broad application. This investigation provides a breakthrough approach for PLA toughening.

4. Associated Knowledge Areas

KA Code	Knowledge Area
511	New and Improved Non-Food Products and Processes

Outcome #3

1. Outcome Measures

Product application development of microcellular foaming technology of biocomposites

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	1	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Dual compatibilization process developed in which poly(2-ethyl-2-oxazoline) and polymeric methane diphenyl diisocyante yielded poly (lactic acid) /soy protein concentrate blends having greater strength than that of pure poly (lactic acid).

What has been done
This investigation clarifies the influence of water and glycerol (co-plasticizers in soy protein plastics) on plasticization and morphology and demonstrated that plasticization and shear stress interplay in determining the morphological structure of the blends.

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
511	New and Improved Non-Food Products and Processes

V(H). Planned Program (External Factors)

External factors which affected outcomes
- Public Policy changes
- Government Regulations

Brief Explanation

V(I). Planned Program (Evaluation Studies and Data Collection)

Evaluation Results

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 15

1. Name of the Planned Program

Program in Biological Systems Engineering

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships			5%	
111	Conservation and Efficient Use of Water			5%	
112	Watershed Protection and Management			5%	
133	Pollution Prevention and Mitigation			5%	
205	Plant Management Systems			10%	
402	Engineering Systems and Equipment			10%	
403	Waste Disposal, Recycling, and Reuse			10%	
404	Instrumentation and Control Systems			10%	
501	New and Improved Food Processing Technologies			15%	
502	New and Improved Food Products			5%	
503	Quality Maintenance in Storing and Marketing Food Products			5%	
511	New and Improved Non-Food Products and Processes			15%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	37.9	0.0
Actual	0.0	0.0	48.4	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
0	0	634420	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	614885	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	4633915	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

We support a vigorous graduate research program crucial to the development of high quality research in our focal areas of interest. We are developing and evaluating innovative water/soil management practices that mitigate the effects of uncertain water resources (both precipitation and irrigation) and other factors associated with climate change and atmospheric CO2 elevation. We have developed a roadmap for bioproducts and bioenergy technology that is specific to the region's energy needs and to the crops/biomass grown in the region. We are developing food processing technologies that provide nutritious new products, increase the safety of existing products, and help improve the overall health of the population. We are developing automated systems and sensors to facilitate mechanized operations for specialty crops.

2. Brief description of the target audience

The target audience is the scientific community in biological systems engineering, general agriculture, agribusiness, extension personnel, growers in the region, state, national, and non-governmental agencies.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	2900	14000	20	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2010

Actual: 3

Patents listed
Lei, Hanwu and Ren, Shoujie. 2010. Method and apparatus for biomass torrefaction and pyrolysis. Filed patent (61/404,560). October 4, 2010.

Yang, Bin. 2010. Bioprocessing of carbon dioxide to hydrocarbons. Filed patent (61/355,932). June 17, 2010.

Chen, Shulin; Frear, Craig; and Zhao, Quanbao. 2010. Integration of anaerobic digestion in an algae-based biofuel system. Filed patent. October 18, 2010.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	0	70	70

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer Reviewed Journal Articles

Year	Actual
2010	70

Output #2

Output Measure

- Graduate Students supported on Agricultural Research Center and grant funds

Year	Actual
2010	37

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Conduct laboratory bench research on processing technologies for agricultural feedstocks to produce new products, and new energy sources.
2	Conduct pilot scale research on processing agricultural feedstocks to produce new products or energy sources.
3	A processing concept to produce new products or energy sources from agricultural commodities is available for transfer.
4	Food processing Technology concept tested at the laboratory and pilot scale.
5	Development or application of computer models to analyze agricultural systems.
6	Initiate Research Activities in Agricultural Automation
7	Conduct field research for soil and water conservation and to improve the environmental impacts of agriculture.

Outcome #1

1. Outcome Measures

Conduct laboratory bench research on processing technologies for agricultural feedstocks to produce new products, and new energy sources.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	2	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Adding agricultural feedstocks to produce new products and energy sources will be of significant benefit to producers in developing new uses for agricultural byproducts and to consumers in developing new ways to produce energy sources and other useful products.

What has been done
The goal of the research is to develop rural bio-oil refineries to convert bio-oils into high value products (ethanol, anti-oxidants, fuel additives). An intermediate step is to convert lignocellulosic materials into desirable intermediaries. The researchers have designed and built a reactor and other equipment necessary to move this research forward. Preliminary results showed only modest increases in the yield of sugars produced by a mild thermal pretreatment with yields determined by the type of feedstock. Adding H2SO4 and NH4H2PO4 doubled the sugars produced, but reduced the yield of oligomers that are also precursors for the production of transportation fuels.

Results
Results of the research produced information on the production of sugars and lignin from agricultural feedstocks. The research has advanced the understanding of the effect of alkalines on the biomass thermal degradation mechanisms and on methods of controlling the operation of two stepped condensers used to separate small oxygenated molecules from the precursors of transportation fuels.

4. Associated Knowledge Areas

KA Code	Knowledge Area
402	Engineering Systems and Equipment
403	Waste Disposal, Recycling, and Reuse

511 New and Improved Non-Food Products and Processes

Outcome #2

1. Outcome Measures

Conduct pilot scale research on processing agricultural feedstocks to produce new products or energy sources.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	2	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Adding agricultural feedstocks to produce new products and energy sources will be of significant benefit to growers in developing new uses for agricultural byproducts and to consumers in developing new ways to produce energy sources.

What has been done
Feedstocks under study are bark from trees commonly harvested in forests in Washington, straw from crops, and manure from a dairy. The work on bark is proceeding with results as noted above. The work on manure is more advanced, especially in regard to computer modeling of anaerobic digestion and understanding the basic chemical and biochemical reactions.

Results
Results with regard to tree bark and forest byproducts are shown in outcome 1. The goal of the project involving anaerobic digestion of manure is to recover the ammonia nitrogen from the effluent of manure and to upgrade the biogas. Results of research at a pilot-scale nutrient recovery system showed that more than 80% of the ammonia was removed during the pilot test. In addition, 40% to 45% (w/w) of the ammonium sulfate was produced as a liquid fertilizer. Further studies involved mathematical models for removing useful chemicals and the basic chemistry of isolating useful chemicals and of removing hydrogen sulfide.

4. Associated Knowledge Areas

KA Code	Knowledge Area
402	Engineering Systems and Equipment
403	Waste Disposal, Recycling, and Reuse

511 New and Improved Non-Food Products and Processes

Outcome #3

1. Outcome Measures

A processing concept to produce new products or energy sources from agricultural commodities is available for transfer.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Adding agricultural feedstocks to produce new products and energy sources will be of significant benefit to growers in developing new uses for byproducts and to consumers in developing new ways to produce energy sources.

What has been done
The nutrient recovery system that was patented last year continues to be tested and improved. The pilot testing is in collaboration with private industry, including a manufacturer of anaerobic digesters and a dairy farm in Wisconsin. The improvements in the technology are reducing the capital and maintenance costs of nutrient recovery systems. The research is expanding to include organic material in municipal waste.

Results
The results of the research are improving systems to recover nutrients from manure, especially dairy waste. The research team wrote a feasibility study of nutrient recovery from digested dairy manure for King County, Washington. A member of the research team made a presentation at a regional anaerobic digestion conference with an audience primarily of farmers and state agency staff members.

4. Associated Knowledge Areas

KA Code	Knowledge Area
403	Waste Disposal, Recycling, and Reuse
511	New and Improved Non-Food Products and Processes

Outcome #4

1. Outcome Measures

Food processing Technology concept tested at the laboratory and pilot scale.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	1	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The development of technologies in food engineering will improve food processing, making processed food safer, healthier, and more flavorful. These developments are especially important in maintaining the competitiveness of the food industry in the United States in the midst of international competition.

What has been done
Part of the work is focused on developing basic understanding of engineering properties of foods to develop better mathematical models for microwave and radio frequency heating processes. This work is proceeding to the development of technologies to improve microwave and radio frequency processes and to develop scale-up systems for industrial applications. A second area of research is developing a stability map of selected functional foods in order to design packaging systems that can include these foods and store them on shelves for significant periods of time.

Results
The work on microwave processing of food, based on patents held by WSU, earned a second approval from the US Food and Drug Administration, this one for using microwaves to sterilize non-homogeneous food. The first microwave sterilization consortium organized and led by WSU has met its objectives and disbanded. A second consortium has formed, comprised of major companies in food processing, food equipment, and food packaging. Further research on extruding and drying potatoes and legumes to produce nutritious snack foods has proceeded to the point of collaborators conducting taste tests among community members. With regard to studies of functional foods, a study of degradation of anthocyanin, a flavonoid, in raspberries either frozen or freeze-dried under various conditions revealed the best conditions for long-term storage to preserve the anthocyanin. This information is useful in determining the optimal storage and packaging conditions for berries.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
503	Quality Maintenance in Storing and Marketing Food Products

Outcome #5

1. Outcome Measures

Development or application of computer models to analyze agricultural systems.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	2	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The development of computer models is of substantial benefit to people making decisions in a variety of ways regarding agriculture. Agencies, consultants, extension personnel, and producers can make better decisions about potential for developing crops or for changing practices. Models provide better information to people making decisions about the use of land and about conserving resources such as soil, water, and nutrients. Such models can also be developed and used to determine the role of agriculture in storing carbon in the soil and in changing the rates of emission of greenhouse gases, and to estimate the impact of climate change on agriculture. Work in this department has produced a web-based computer application that growers can use as a scheduling tool for irrigation management. The application makes it possible to optimize water use during times of limited water availability and to project future water needs based on historical averages.

What has been done
Modeling is underway to evaluate soil carbon storage and greenhouse gas emissions based on long-term simulations verified with limited experimental data for selected cropping systems in the State of Washington. The research has expanded to include dairy farms. Modeling is continuing with regard to snow redistribution and water storage at a watershed scale with an emphasis on improving the Water Erosion Prediction Project (WEPP) model. Further research and outreach in irrigation has focused on development of a web-based computerized tool to schedule irrigation for

crops common in Washington, Oregon, and Idaho with subsequent availability for producers.

Results

The research is continuing to adapt computer models to particular purposes. A detailed, well-established canopy photosynthesis and transpiration model was used as a reference to develop a simpler approach more conducive to strategic and tactical management decisions. This model is being coupled with a hydrologic model as a tool aimed at projecting to year 2020 the water supply and demand in the Columbia River Basin. Further model development is aimed at improving the accuracy of predicting nitrogen cycling as a process coupled with the carbon cycle. Crops under study have been expanded to include tree fruits and the research has made an additional expansion into evaluating dairy farms. Researchers are now integrating these models into watershed hydrology models for comprehensive evaluation of water supply and demand as affected by climate change. Research has improved the WEPP model with regard to winter conditions in a freeze-thaw cycle. It was used to evaluate hydrological and erosion processes in the semiarid croplands of the Columbia Plateau in the Pacific Northwest under conventional tillage and no-till farming practices. Research to develop an irrigation scheduling computer program and to make it available to producers has come to fruition. Researchers in the region have developed the program and tested it in Washington, Oregon, and Idaho. It is available on-line as a web-based application based at Oregon State University called IWM-online. It enables growers to optimize their water use during periods of limited water availability and to make projections of future water use based on historical averages. Most producers who tried to use it, however, had difficulty because of its complexity, resulting in a current effort to develop a simplified version.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
205	Plant Management Systems

Outcome #6

1. Outcome Measures

Initiate Research Activities in Agricultural Automation

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	1	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The goal for 2010 was to hire another faculty member in the area of agricultural automation in order to provide sufficient expertise to move forward in this general area of research. This research area is very important for specialty crops in the State of Washington and elsewhere because it holds promise of reducing the labor necessary to plant, manage, and harvest crops that are now labor-intensive.

What has been done
The department has hired a new faculty member in this research area and an existing faculty member left for a different position at the university. We now have two people (a Professor and an Assistant Professor) conducting research and teaching graduate students in the area of agricultural automation. The research has now begun in earnest.

Results
Research is moving forward on several fronts, beginning with the development of a semi-autonomous platform based on a John Deere Gator. Researchers have developed a prototype of a hand-held blossom thinning device and are now testing it in the field. A study of a fundamental harvesting technology for a stem-free sweet cherry has been completed. Three other studies in this area of research have begun this year and are continuing. Field trials have been conducted for an -on the go- tree caliper and counter, for an electronic pest trap prototype based on infra-red sensors and on bio-impedence sensors, for crop load estimation with vision scout, and for graphic-command interface for an autonomous prime mover and row following and turning algorithms.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
402	Engineering Systems and Equipment
404	Instrumentation and Control Systems

Outcome #7

1. Outcome Measures

Conduct field research for soil and water conservation and to improve the environmental impacts of agriculture.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Agriculture makes significant use of natural resources, especially land and water, and can have serious detrimental effects on the environment (soil, water, and air). Recent research has mitigated both of these factors and offers continuing promise toward further reductions in the use and conservation of resources and the production of certain kinds of pollution. A study of sub-lethal impacts in salmonids induced by environmentally relevant contaminant mixtures, especially endocrine disrupting chemicals, is determining the presence of these contaminants in streams in the State of Washington and the effects on fish. In some other places, these contaminants have interfered with the reproductive ability of fish. Another study on ways to reduce ammonia produced in confined animal feeding operations is working toward reducing ammonia released into the atmosphere in an effort to reduce greenhouse gases.

What has been done
As noted in item 5, the WEPP computer model has been used to study differences in snow distribution and water in the soil under conventional and no-till farming methods. Part of the work involves field measurements to test the model. The study of endocrine disrupting chemicals has started to produce results with regard to presence of the chemicals in streams and the effects on salmonids. The study on ammonia production has considered various options that might reduce the amount of ammonia released into the atmosphere from confined feeding operations.

Results
Improvements in the WEPP model have it more useful in predicting snow packs, water storage, and runoff in watersheds with frozen ground in the winter. Field measurements have resulted in adjustments to the model to bring it into line with observations. Researchers are compiling the results of the study of endocrine disrupting chemicals. Research on reducing ammonia emissions from confined animal feeding operations revealed that reducing the crude protein content in the diet of dairy cattle decreased irreversible loss of ruminal ammonia, which reduced the potential for ammonia loss from excreted manure without affecting cow performance.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
205	Plant Management Systems

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Competing Public priorities
- Competing Programmatic Challenges
- Other (Changes in Market)

Brief Explanation

Changes in any of these external factors would have a major effect on the conduct of this research. Much of the research is heavily dependent on appropriations, on public policy decisions, and on public priorities. In the last few years, these factors have favored the research in this department as more money has been made available at the state and national level, especially with regard to USDA competitive grants and contracts, with regard to research being conducted in this department. These changes have enhanced the research, but other changes might provide challenges to further development.

V(I). Planned Program (Evaluation Studies and Data Collection)

Evaluation Results

The department chair compares this department with other similar departments across the country every year. The results show that the department is generally performing at least in the top five among its peers in several categories.

Key Items of Evaluation

The department chair each year conducts a quantitative and qualitative survey regarding annual activities with information from WSU taken from faculty reports of activity. Achievements for the year are compiled and compared with benchmark targets. Items of evaluation include refereed publications per faculty member, extramural money spent per faculty member, and graduate students per faculty member.

V(A). Planned Program (Summary)

Program # 16

1. Name of the Planned Program

Institute of Biological Chemistry

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
201	Plant Genome, Genetics, and Genetic Mechanisms			15%	
202	Plant Genetic Resources			2%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants			31%	
204	Plant Product Quality and Utility (Preharvest)			2%	
205	Plant Management Systems			4%	
206	Basic Plant Biology			27%	
211	Insects, Mites, and Other Arthropods Affecting Plants			8%	
511	New and Improved Non-Food Products and Processes			5%	
701	Nutrient Composition of Food			6%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	63.0	0.0
Actual	0.0	0.0	63.6	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
0	0	214587	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	209826	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	9871797	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

The Institute of Biological Chemistry has a very vigorous graduate research and training program in fundamental plant biology, especially including plant biochemistry, physiology, and molecular genetics. This leads to the graduation and placement of its highly trained (Ph.D./M.S.) scientists, to publications in high quality journals, to developing patents and working with industry to implement the technologies developed, as well as carrying out needed outreach activities (e.g. to focus groups, high school students, general public, etc.).

2. Brief description of the target audience

The primary target audience of the Institute of Biological Chemistry is scientists within various disciplines in plant biotechnology, particularly plant biochemistry. Their research activities attract attention within the biochemical, forest products, and agricultural industries.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2010

Actual: 3

Patents listed
1.Production of small molecules in glandular trichome-bearing plants. Lead Inventor, Dr. Bernd M. Lange, PCT/US10/28789. US Patent Application.
2.Arogenate Dehydratases and Lignification. Lead Inventor, Dr. Norman Lewis Ph.D. Provision filed in 2010. Our Intellectual Property Office requires that we not provide application numbers or filing dates until published.
3.Methods to increase plant productivity and Yields. Dr. Thomas Okita. Provision filed in 2010. Our Intellectual Property Office requires that we not provide application numbers or filing dates until published.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	0	41	41

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer reviewed journal articles

Year	Actual
2010	41

Output #2

Output Measure

- Supporting graduate students on Agricultural Research Center and External Funding

Year	Actual
2010	26

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Increase numbers of qualified graduate students
2	Patents
3	External Funding in millions of dollars
4	Peer reviewed journal articles

Outcome #1

1. Outcome Measures

Increase numbers of qualified graduate students

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	28	26

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Additional (quality) students will result in more highly trained plant researchers, addressing topical/priority areas, such as bioenergy/biofuel and bioproducts development, photosynthesis, nutritional improvement of protein, starch and lipid quality in seeds and plants, understanding of metabolic pathways (enabling one to re-engineer plant forms to enhance formation of metabolites with health related significance) and other potentially useful basic research. Such areas are critical to plant productivity, human health and nutrition, bioenergy/bioproducts research, as well as to allied industries.

What has been done
The Department of Chemistry at Washington State University began a new graduate program in 2008 entitled Chemistry in Biological Systems. This program recruits students with strong chemistry backgrounds, with an interest in biological systems, to Washington State University. In turn, those interested in plants are drawn into (bio)chemistry-related research programs at the IBC, and this is being used for future active recruiting of chemistry/biology-oriented students. Chemistry holds a recruitment program in March and we also recruit many of our current students through the Molecular Plant Sciences (MPS) Graduate program, and to a lesser extent in the School of Molecular Biosciences (SMB) and Department of Chemical Engineering. MPS holds an Integrated Plant Sciences Retreat and recruitment program each February, as does SMB. Top ranked students in the nation who have applied to these programs are invited to meet with faculty at the retreats. Students with strong biochemistry backgrounds may directly enter IBC laboratories as a result (without undergoing a rotation through various faculty labs during the first year of graduate school) under a program called Accelerated PhD. To help support and recruit these students, most of the IBC faculty are also involved in a NIH-supported Protein Biotechnology grant. Other methods of recruitment involve mailing recruitment posters to various (often including land-grant) universities in the United States. Prospective students also contact IBC researchers directly, e.g. via email.

Results
During 2010, one tenured professor left IBC for employment at another university. The IBC now has nine faculty researchers, of which one is an assistant professor, two are newly promoted associate professors, one is on 50% phased retirement, and another is in a full-time administrative position within the Agricultural Research Center. As the newer members begin to obtain additional extramural funding, the IBC expects to be able to support more graduate students thereby leveraging existing resources. The individual on phased retirement no longer takes graduate students and will retire in 2012.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
206	Basic Plant Biology
701	Nutrient Composition of Food

Outcome #2

1. Outcome Measures

Patents

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	1	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The award of patents for research protects intellectual property. If licenses are obtained by other entities to use the research, this generally results in royalties and/or contracts coming to the University, the IBC and, to some extent, the researcher. Novel and useful research results are an indication that researchers are making important discoveries.

What has been done
Three patent applications were filed in 2010; none were awarded.

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
206	Basic Plant Biology
211	Insects, Mites, and Other Arthropods Affecting Plants
511	New and Improved Non-Food Products and Processes
701	Nutrient Composition of Food

Outcome #3

1. Outcome Measures

External Funding in millions of dollars

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	5	8192364

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Actual fiscal year extramural funds July 1 2009 - June 30, 2010 = $9,331,183. Estimated extramural funds for Fiscal Year July 1, 2010 - June 30, 2011 as of 12/31/2010 are $8,192,364. In addition to the actual funds received, the IBC also had four PhD students who received outside funding to finance their educations. The first three students received two years of stipends and tuition through the NIH Protein Biotechnology Grant managed by Dr. Ray Reeves in the School of

Molecular Biosciences. The fourth student is a Fulbright Scholar who received salary and tuition during her first academic year (2010-2011). This funding for the four student salaries and tuition is extrapolated to be $94,966, raising the 2010-2011 estimate to $8,287,330.

Extramural funds are necessary for financing research at the Institute of Biological Chemistry.

What has been done
Principal Investigators submit competitive research proposals to federal agencies such as the National Science Foundation, United States Department of Agriculture, Department of Energy and the National Institutes of Health, as well as negotiating contracts with private industries (Monsanto, Dow Chemical, Bayer, Boeing, Philip Morris, Mint Industry Council, etc.).

Results
Since fiscal year 2000, extramural funds have increased from $4.8 million to $8.1 million, a positive change of over 70%. Tenured/tenure track faculty FTEs receiving a salary through the Institute was 8.5 in 2010. One additional FTE from the Agricultural Research Center also maintains a research program in the Institute. Average funding per tenured/tenure track faculty in 2010 was 8,192,364/9.5/= $862354.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
206	Basic Plant Biology
211	Insects, Mites, and Other Arthropods Affecting Plants
511	New and Improved Non-Food Products and Processes
701	Nutrient Composition of Food

Outcome #4

1. Outcome Measures

Peer reviewed journal articles

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	30	41

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Peer reviewed journal articles are important because they generate research results that meet certain standards; for example, experiments are repeatable, results are understandable, and the article has been reviewed by credible and knowledgeable individuals. When published in quality journals, these articles generally represent evidence of substantial progress in research.

What has been done
Tenured/tenure-track faculty work with undergraduates, graduate students, postdoctoral research associates and collaborators to write thorough and accurate reports of research and research findings. Graduate students or postdoctoral research associates may be first listed authors who have had the opportunity to learn how to translate their research into scientific publication (products) under the mentoring of the research leader. When complete, an article is submitted to an appropriate journal, such as Phytochemistry or Plant Cell, etc., and is reviewed on its own merit. Articles may be returned to the authors with recommendations for further research before publishing, or for revisions.

Results
Target level has been exceeded for 2010.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
206	Basic Plant Biology
211	Insects, Mites, and Other Arthropods Affecting Plants
511	New and Improved Non-Food Products and Processes
701	Nutrient Composition of Food

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

The Institute was awarded several economic stimulus ARRA grants during 2009, which positively affected extramural income during 2009 and 2010. There also still seems to be a deliberate intention by Congress to support biofuel/bioenergy research. Some funding opportunities in 2009 and 2010 were partially affected (increased) by a nationwide interest in biofuel development, resulting in continued funding to IBC researchers.

The IBC is in an excellent position to conduct research directed to development of potential feedstocks, such as biofuels from poplars and other species. All indications are that this will continue to be a federal/state high priority for future (energy-related) research.

A faculty member left IBC in 2010, transferring to Michigan State University. As his graduate students, laboratory and extramural funding were taken with him, it is expected that our planned outcomes will be reduced somewhat in the future.

V(I). Planned Program (Evaluation Studies and Data Collection)

Evaluation Results

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 17

1. Name of the Planned Program

Program in Crop Genetics and Breeding

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
201	Plant Genome, Genetics, and Genetic Mechanisms			25%	
202	Plant Genetic Resources			15%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants			20%	
204	Plant Product Quality and Utility (Preharvest)			10%	
206	Basic Plant Biology			10%	
211	Insects, Mites, and Other Arthropods Affecting Plants			5%	
212	Pathogens and Nematodes Affecting Plants			15%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	50.0	0.0
Actual	0.0	0.0	49.3	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
0	0	181365	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	181347	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	5387540	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Faculty members in the Department of Crop and Soil Sciences developed, tested, patented (PVP), and released new commercial cultivars of spring and winter wheat and of spring barley for conventional and targeted management systems, such as direct seed, low-input, organic, perennial, and integrated animal-based cropping. We identified and/or elucidated the mechanisms of gene function leading to enhanced disease resistance, quality attributes, abiotic stress tolerance, emergence from deep sowing depths, cold tolerance, herbicide resistance, and genetic recombination. We filed patents on biologically unique organisms (varieties), genes, and processes. We published peer-reviewed journal articles on the development of new breeding techniques that improve efficiency by using genetic markers (marker assisted selection, marker assisted backcross selection), quantitative trait loci (QTLs), single nucleotide polymorphisms (SNPs), and a variety of other molecular, statistical, and genetic/genomic techniques, on wheat and barley genomes, and genome structure and function. We published peer-reviewed journals and advanced technology transfer of novel end use purposes for food, medicine, bioproduct and bioenergy applications for commercial adaptation.

2. Brief description of the target audience

The target audience includes other basic and applied plant scientists, plant breeders, economists, commodity commissions, policy makers, legislators, agribusiness, food processors, and farmers.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	4000	45000	250	1500

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2010

Actual: 2

Patents listed
1. Neff, M. (submitted, October). Genetic manipulation of the AT-hook domain in plant AHL genes to modulate cell growth.
2. Ullrich, S.E. (submitted). Identification of a point mutation in barley acetohydroxy acid synthase (HvAHAS) gene.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	10	34	44

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer reviewed journal publications

Year	Actual
2010	29

Output #2

Output Measure

- Graduate students supported on Agricultural Research Center or other external funds

Year	Actual
2010	28

Output #3

Output Measure

- Plant Patents and plant variety protections (PVPs)

Year	Actual
2010	4

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Publications on improved knowledge of wheat, barley genetics, genome, new breeding tools impacting the national, international breeding, and genetic scientific community
2	Commercial cultivar releases that are adapted regionally.

Outcome #1

1. Outcome Measures

Publications on improved knowledge of wheat, barley genetics, genome, new breeding tools impacting the national, international breeding, and genetic scientific community

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	25	29

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Publications on aspects of genetics and breeding affect the international community of cereal geneticists and plant breeders. Expanded knowledge in these areas allows accelerated progress in understanding genes, genetic mechanisms, and breeding processes, particularly in barley and wheat.

What has been done
We reported on herbicide resistance in weeds and crops; inheritance of seed dormancy and pre-harvest sprouting in barley; wheat and barley end use quality traits; new systems and approaches in genetic analysis; genetic analyses of wheat and barley rust and other pathogen resistance, wheat chromosome pairing, wheat coleoptile length; and breeding methodologies for organic, low input and perennial wheat production systems.

Results
New information has been gained to better understand the genes involved and inheritance patterns of wheat and barley rust and other pathogen resistance; wheat and barley end use quality, coleoptile length, and chromosome pairing; herbicide resistance genes in crops and weeds; and genes for dormancy and pre-harvest sprouting in barley. In several cases genes have been mapped and molecular markers identified, which will aid in breeding of improved disease resistance, reduced pre-harvest sprouting in barley, improved end-use quality of wheat, and improved emergence of wheat from deep sowing depths. New knowledge also will aid small grain breeding for organic, low input and perennial production systems.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms

203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
204	Plant Product Quality and Utility (Preharvest)
206	Basic Plant Biology
212	Pathogens and Nematodes Affecting Plants

Outcome #2

1. Outcome Measures

Commercial cultivar releases that are adapted regionally.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	2	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
New grain cultivars represent improvements over existing cultivars, which benefit farmers, processors, exporters, and/or end users in terms of increasing yield and enhancing end-use quality. Variety development is followed closely, especially by farmers and processors, and new varieties adopted readily by the cereal industry.

What has been done
One new spring wheat was release in 2010; three breeding lines (1 spring barley, 2 winter wheat) were approved for breeder seed increase. Scientists collaborated on one other release outside of the region, and on three registration and PVP documents for previously-released wheat cultivars from Washington.

Results
New cereal cultivars will give farmers more options to plant in rotations and under challenging abiotic and biotic stress conditions. Releases represent improved end use quality that will provide new export opportunities. In 2009 in Washington State, approximately 32% of the 2,400,000 acres sown to wheat were WSU cultivars, while about 13% of the 200,000 acres sown to barley were WSU cultivars. The proportional earnings from WSU wheat and barley cultivars harvested were estimated at $370 and $8 million, respectively. The WSU cereal variety testing program provided information to growers, which enabled them to select improved cultivars vs. average cultivars. It was estimated that this information alone, when used as an aid in variety selection, had a value of $15 million/yr to farmers in terms of increased yield and quality returns.

4. Associated Knowledge Areas

KA Code	Knowledge Area
202	Plant Genetic Resources
204	Plant Product Quality and Utility (Preharvest)
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

Major factors in 2010 include a wet, cold spring followed by localized drought, which impacted field trials, particularly in spring wheat, and resulted in the total loss of several cultivar test sites; localized winter injury and emergence problems in the low rainfall zone; and stripe rust disease associated with an extended cool, wet spring. We executed several program reorganizations in cereal breeding and variety testing, which will allow these programs to move forward again fully staffed in 2011. Ongoing reductions in public (state and federal) funding resulted in further net FTE reductions created when vacant positions went unfilled.

V(I). Planned Program (Evaluation Studies and Data Collection)

Evaluation Results

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 18

1. Name of the Planned Program

Program in Sustainable Crop and Soil Managment

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
101	Appraisal of Soil Resources			18%	
102	Soil, Plant, Water, Nutrient Relationships			2%	
104	Protect Soil from Harmful Effects of Natural Elements			5%	
111	Conservation and Efficient Use of Water			10%	
132	Weather and Climate			5%	
133	Pollution Prevention and Mitigation			3%	
141	Air Resource Protection and Management			5%	
205	Plant Management Systems			17%	
213	Weeds Affecting Plants			10%	
404	Instrumentation and Control Systems			2%	
405	Drainage and Irrigation Systems and Facilities			5%	
601	Economics of Agricultural Production and Farm Management			3%	
701	Nutrient Composition of Food			3%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins			5%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities			5%	
903	Communication, Education, and Information Delivery			2%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	39.9	0.0

Actual	0.0	0.0	36.6	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
0	0	335253	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	335253	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	3828050	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Faculty in the Department of Crop and Soil Sciences worked to develop bioproducts and bioenergy from crop residues; demonstrated high quality and safe food from organic and sustainable production systems; documented ecosystem services provided by sustainable cropping systems; improved the efficiency and safety of waste recycling systems in agricultural production; identified soil biological organisms important in crop production, residue decomposition and soil building; developed soil management programs for new crop species and cultivars of evolving cropping systems in collaboration with crop genetic and breeding teams; published peer-reviewed journal articles on unique findings related to the above topics; and disseminated information on the above systems to facilitate adoption and commercialization.

2. Brief description of the target audience

The target audience includes other soil scientists, cropping systems agronomists, economists, commodity commissions, policy makers, legislators, agribusiness, and farmers.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	15500	73500	225	550

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2010

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	14	41	55

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer reviewed journal publications

Year	Actual
2010	35

Output #2

Output Measure

- Graduate students supported by Agricultural Research Center and other external funds

Year	Actual
2010	34

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Publications dealing with improved knowledge of crop rotations, nutrient cycling, soil building and carbon sequestration, fertility management, soil structure and soil water movement, and chemical movement in soils, tools for spatial monitoring and management.

Outcome #1

1. Outcome Measures

Publications dealing with improved knowledge of crop rotations, nutrient cycling, soil building and carbon sequestration, fertility management, soil structure and soil water movement, and chemical movement in soils, tools for spatial monitoring and management.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	25	35

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Publications on various aspects of sustainable crop and soil management affect the international community of agronomists and soil scientists. Expanded knowledge in these areas allows progress in understanding basic aspects of sustainable crop production practices, including the production of crops for food, fiber and energy. This, in turn, allows progress in developing best management practices, which directly benefits farmers and their success, and indirectly the greater public, as the environment improves and food production costs are kept low.

What has been done
Numerous experiments were conducted. Reports and presentations were delivered on weed ecology and control in crops; fertilization of crops to optimize nutrient use efficiency; fertilization effects on grain and residue composition, decomposition, and processing; organic crop production practices; crop rotation and direct seeding / reduced tillage methods and their effects on erosion, production and economics; improved methods of measuring soil physical, chemical, and microbial parameters; and the sociological effects of alternative farming practices.

Results
Better understanding has been gained of the ecology and control of weeds in Washington State and regional crops and environments. It was estimated that the adoption of one new herbicide alone saved farmers approximately $13 million across the region, and reduce the chemical load in the environment by approximately 120,000 lbs. The cost of soil erosion in the Palouse region of eastern Washington alone has been >$70 million/yr due to lowered crop yields, lost nutrients, and sediment cleanup. Adoption of reduced tillage methods has reduced erosion by 25-50% with a cost savings of up to $35 million/yr. This has improved water and air quality in the region as well. Improved fertilizer application methods in cereals, vegetables, forages, oilseeds, grape, and turfgrass production systems has reduced production costs and nutrient runoff and leaching with

a cost savings of >$5 million/yr and reduced nitrogen emissions into the atmosphere by 80,000 lbs annually. Organic agriculture production has risen dramatically in Washington partly due to increased demand and partly due to WSU's emphasis on education and production methods research.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
133	Pollution Prevention and Mitigation
141	Air Resource Protection and Management
205	Plant Management Systems
213	Weeds Affecting Plants
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
803	Sociological and Technological Change Affecting Individuals, Families, and Communities

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

Major factors affecting outcomes in 2010 include a cool, wet spring followed by localized drought, which impacted field research results and resulted in the compromise or loss of several field studies. The state and national economy have affected hiring and the ability to restaff key vacancies created by retirements and resignations. Higher crop prices and production input costs (= higher risk) have impacted farmer inclination to adopt new technologies, especially soil conservation measures. Increased costs of inputs affecting farmers also affect researchers.

V(I). Planned Program (Evaluation Studies and Data Collection)

Evaluation Results

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 19

1. Name of the Planned Program

Global Food Security and Hunger

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
101	Appraisal of Soil Resources			3%	
102	Soil, Plant, Water, Nutrient Relationships			5%	
104	Protect Soil from Harmful Effects of Natural Elements			3%	
111	Conservation and Efficient Use of Water			7%	
112	Watershed Protection and Management			3%	
121	Management of Range Resources			3%	
201	Plant Genome, Genetics, and Genetic Mechanisms			9%	
202	Plant Genetic Resources			8%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants			9%	
205	Plant Management Systems			6%	
206	Basic Plant Biology			5%	
211	Insects, Mites, and Other Arthropods Affecting Plants			8%	
212	Pathogens and Nematodes Affecting Plants			9%	
213	Weeds Affecting Plants			3%	
215	Biological Control of Pests Affecting Plants			5%	
216	Integrated Pest Management Systems			4%	
301	Reproductive Performance of Animals			3%	
302	Nutrient Utilization in Animals			3%	
303	Genetic Improvement of Animals			2%	
304	Animal Genome			2%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Extension	Research

Year: 2010	1862	1890	1862	1890
Actual	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

V(D). Planned Program (Activity)

1. Brief description of the Activity

Because the work reported for 2010 in the annual review of the older Planned Programs includes effort that will be duplicated by also reporting under the newly mandated goals, quantitation of effort is not included under Inputs. However, we estimate that about 56% of Hatch expenditures were in this area.

Since making a decision many years ago to focus research efforts on aspects of agricultural production, the WSU Agricultural Research Center has invested heavily in areas like basic plant and animal science, agricultural productivity, sustainable agriculture, cropping systems, agricultural economics, pest and pathogen control, food processing and agricultural mechanization. Much of this research is directed toward the major agricultural products of the state, like wheat, barley, dry legumes, tree fruit, wine grapes, onions, produce, berries, hay, dairy and beef cattle, but this research effort also extends to minor state crops and, in some cases, crops that are not grown here at all, like rice. The goals are diverse but have the common theme of trying to produce quantity and quality, while minimizing the need for off-farm inputs like farm chemicals and while maintaining soil productivity and environmental quality. Special funding is available for long-term cropping research and sustainable production practices, including organic farming. Although Extension reports separately, it is important to note that there is considerable integration of effort between Research and the consumers of that research. One index of this is the recent success of WSU programs in competing for Specialty Crop Research Initiative funds and other USDA competitive grants that emphasize integrated programs. Much of the research we do is applicable to other areas of the world with similar climates, a component of recent success in securing international ly focused grants like a project from the NSF BREAD program.

Notable events this year include: Acquisition of major NIH and Life Science Discovery Fund grants to explore the possibility of developing a wheat variety that lacks the antigenic components responsible for celiac disease; Funding of major programs in research into plant lipid metabolism, plant steroid metabolism, plant secondary compound biosynthesis and plant macromolecule localization; Obtaining FDA approval for microwave sterilization of salmon filets, a test material representing heterogeneous food products; Expansion of programs involved in sustainable and organic agriculture; Funding of a major program to explore the use of plants and landscape design to deal with pollution problems caused by

storm water interactions with distributed sources in urban areas; Expansion of programs dealing with diseases of wheat, onion and cut flower bulb crops, grapevines and caneberries and the expansion of a new insect pest, Spotted Wing Drosophila; and Continuation of major efforts in wheat, tree fruit and potato improvement.

2. Brief description of the target audience

For the researchers, the initial audience is other researchers who can validate and test their conclusions and determine whether they can be used in other agricultural environments. The ultimate audience is producers and processors involved in delivering agricultural products to the market, and includes regulators and policy makers. Ultimately, the value of much of the work is determined by market prioritization and by efforts to make the production systems sustainable by including various ecosystems services and human resource costs in determining the cost of production.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2010

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	0	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- {No Data Entered}

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

Outcome #1

1. **Outcome Measures**

{No Data Entered}

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

Changes in funding patterns have affected all research programs at the university but especially worrying is the serious decline in state funding that can be reallocated at the level of the Agricultural Research Center. This trend is likely to continue for at least another two years and will have significant consequences for the strength of our research programs. While our faculty have been working hard to obtain external funding to substitute for some of this state support, contraction at the federal level presents us with what has been described as a Perfect Storm, which has the potential to severely impact the land grant mission of supporting agricultural industries in the state and region.

V(I). Planned Program (Evaluation Studies and Data Collection)

Evaluation Results

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 20

1. Name of the Planned Program

Climate Change

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships			5%	
111	Conservation and Efficient Use of Water			5%	
112	Watershed Protection and Management			5%	
122	Management and Control of Forest and Range Fires			5%	
123	Management and Sustainability of Forest Resources			5%	
132	Weather and Climate			5%	
133	Pollution Prevention and Mitigation			5%	
201	Plant Genome, Genetics, and Genetic Mechanisms			10%	
202	Plant Genetic Resources			5%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants			10%	
205	Plant Management Systems			5%	
211	Insects, Mites, and Other Arthropods Affecting Plants			10%	
212	Pathogens and Nematodes Affecting Plants			10%	
213	Weeds Affecting Plants			3%	
216	Integrated Pest Management Systems			5%	
404	Instrumentation and Control Systems			2%	
605	Natural Resource and Environmental Economics			5%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2010	Extension		Research	
	1862	1890	1862	1890

Actual	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
0	0	0	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	0	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Because the work reported for 2010 in the annual review of the older Planned Programs includes effort that will be duplicated by also reporting under the newly mandated goals, quantitation of effort is not included under Inputs. However, we estimate that about 14% of Hatch expenditures were in this area.

Except for the work described under the Program in Sustainable Energy, our research portfolio is not targeted directly to changing factors leading to climate change. Instead, our work in this area is primarily an extension of our research programs that deal with agriculture in a region with diverse microclimates and one where year-to-year variation in weather can have important implications for that year's crop production. Thus our focus is more about dealing with climate change and ameliorating its effects than in preventing it but we are not ignoring areas where changing farm practices might make a difference in carbon sequestration.

Areas where we have strength in Climate Change related research include: (1) Adopting and adapting new crops to specific areas within the Pacific Northwest region; (2) Using weather inputs as real-time variables in crop protection, especially with regard to insects and pathogens; (3) Modeling the potential consequences for the region of changed weather patterns.

In trying to plan for changes in local climate that may accompany global warming and understanding the implications of these changes for regional agriculture, it is important to realize that our growers already deal with significant variation in local climate. For example, in the Palouse wheat-growing region, there is a consistent east-west rainfall gradient and a consistent north-south temperature gradient. The latter is also associated with persistence of winter snow cover that makes the wheat crop in the northern parts of the region more susceptible to snow mold. Thus our wheat breeding programs develop varieties that differ in traits related to water use, with a priority for snow mold resistance in varieties that will be used in northeastern Washington.

To keep up with the speed of climate change, we will need to do what we already do, only faster. The WSU breeding programs for grains and other crops are already trying to incorporate faster methods of genotyping and phenotyping plants and major investments are being committed to developing improved technology platforms for doing this, including molecular analysis laboratories and a fast photosynthesis evaluation facility for phenotype evaluation. Other breeding strategies are also being used to bring specific traits to the field more rapidly.

Ability to produce under altered climate conditions will be even more important for perennial crops, including fruit trees and grapes, where we are exploring the use of dwarf plants to accelerate development

of new varieties and traits. One of the most likely effects of warmer weather is the expansion of insects and diseases into areas where they had previously been limited by cold winter weather. Current examples of this problem include the invasion of the mountain pine beetle but we anticipate that several diseases, such as Pierce's Disease of grapes, may expand as winter mortality becomes less of a problem for pests and disease vectors. Our ongoing investment in entomology and plant pathology is potentially a defense against these. Local weather data is an input to AgWeatherNet (weather.wsu.edu), a system developed to provide weather tracking information to the WSU Tree Fruit IPM Decision Aids System, an expert system that helps the tree fruit industry predict the potential severity of pest problems so that growers can make decisions about using pesticides that are informed by life history and development models that factor in the weather and projected trajectories of pest and natural control systems. Finally, we have strong programs in modeling the impact of rainfall and temperature on crop growth.

2. Brief description of the target audience

The audience for this work is scientists in adjacent regions, producers who may wish to incorporate the idea that changed temperatures and growing systems may be part of their future, decision makers and the general public.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2010

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	0	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- {No Data Entered}

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

Outcome #1

1. **Outcome Measures**

{No Data Entered}

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

Changes in funding patterns have affected all research programs at the university but especially worrying is the serious decline in state funding that can be reallocated at the level of the Agricultural Research Center. This trend is likely to continue for at least another two years and will have significant consequences for the strength of our research programs. While or faculty have been working hard to obtain external funding to substitute for some of this state support, contraction at the federal level presents us with what has been described as a Perfect Storm, which has the potential to severely impact the land grant mission of supporting agricultural industries in the state and region.

Specifically with regard to this Planned Program, there is considerable resistance in the grower communites to the ideas that the weather is changing in a systematic or novel way or that apparent changes have anthropogenic causes. We already work to develop ways of coping with marginal climates for the local crops so there is not a lot of change in what we are actually doing in this area but we give it higher priority.

V(I). Planned Program (Evaluation Studies and Data Collection)

Evaluation Results

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 21

1. Name of the Planned Program

Sustainable Energy

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships			5%	
123	Management and Sustainability of Forest Resources			5%	
131	Alternative Uses of Land			5%	
133	Pollution Prevention and Mitigation			2%	
141	Air Resource Protection and Management			3%	
201	Plant Genome, Genetics, and Genetic Mechanisms			5%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants			15%	
204	Plant Product Quality and Utility (Preharvest)			15%	
205	Plant Management Systems			5%	
206	Basic Plant Biology			5%	
211	Insects, Mites, and Other Arthropods Affecting Plants			5%	
402	Engineering Systems and Equipment			5%	
403	Waste Disposal, Recycling, and Reuse			10%	
511	New and Improved Non-Food Products and Processes			5%	
601	Economics of Agricultural Production and Farm Management			5%	
603	Market Economics			2%	
605	Natural Resource and Environmental Economics			3%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2010	Extension		Research	
	1862	1890	1862	1890

Actual	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

V(D). Planned Program (Activity)

1. Brief description of the Activity

Because the work reported for 2010 in the annual review of the older Planned Programs includes effort that will be duplicated by also reporting under the newly mandated goals, quantitation of effort is not included under Inputs. However, we estimate that about 11% of Hatch expenditures were in this area.

The primary impacts of our research programs in the area of sustainable energy are: (1) Exploring the potential for altering cropping systems in the Pacific Northwest to include more options for incorporating plants that can be used as energy sources; (2) Altering current agricultural processes to require less energy input; (3) Understanding the basic properties of plant production of potential energy feedstocks with the goal of adding value to biological energy production; (4) Developing methods for using plant derived products as energy sources, including waste wood and landfill materials; and (5) Developing usable models that include energy costs associated with production so that producers can estimate the economic consequences of various production alternatives.

We have projects looking at the regional potential of new "energy crops" like algae, camelina, switchgrass and giant reed, the possibility of using rapidly growing plants like poplar, prickly lettuce and other weeds for their biomass or specialty chemical production and especially to develop methods for using waste wood products and biomaterials from landfills as energy sources. Camelina looks like a promising oilseed crop for inclusion into dry area rotations in what would otherwise be a fallow season. These efforts sometimes include work to increase production by altering cropping practices or by genetic improvement through traditional breeding. Work is also underway to understand how photosynthesis is controlled and to alter the flow of photosynthate to useful energy products, like starch and lipids. The more reduced compounds could lead to potentially higher value fuels than ethanol. Research into reshaping plant allocation strategies is coupled to physiological studies examining the potential consequences for the growth of the whole plant, including properties, such as stress and disease resistance, that would be important in growing crops able to generate biofuels and bioproducts at a competitive price. Because of the diversity of plants grown in the state and the relatively lignified state of the tree biomass identified as a major potential source of energy, pyrolysis is a major conversion option that is being explored, especially small scale pyrolysis that would allow high temperature conversion to be tailored to individual biomass inputs. The cropping research that accompanies some of these projects includes further analysis of low-input farming techniques, like no-till farming in the eastern part of the state, and designed studies of the long-term impact of various farming practices. There is considerable investment in organic farming programs, many of which are associated with the WSU Center for Sustaining Agriculture and Natural Resources, which is investigating various alternatives for growing

crops. Issues that are central include establishing and maintaining the productivity of biofuel crops, many of which are judged by their ability to be productive while minimizing external inputs, including energy and farm chemicals. This research also supported by WSU economists who have been investigating the potential profitability of production alternatives.

2. Brief description of the target audience

Because the implications of sustainable energy development are diverse, there is a similar diversity in the audience for this research. A study carried out by WSU economists that was commissioned by the Washington legislature and released in late 2008, has helped shape state energy policy and defined where our production might fit in the energy market. Some of this is reflected in the research priorities described above. More generally, the research has found several target audiences, from farmers considering long-term strategies with regard to cropping and production practices, to the US Department of Energy, which funds several of our investigators, especially in the basic science areas. The audiences include other scientists working in similar areas, industry scientists, and decision makers at several levels.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2010

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	0	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- {No Data Entered}

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

Outcome #1

1. **Outcome Measures**

{No Data Entered}

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

Changes in funding patterns have affected all research programs at the university but especially worrying is the serious decline in state funding that can be reallocated at the level of the Agricultural Research Center. This trend is likely to continue for at least another two years and will have significant consequences for the strength of our research programs. While or faculty have been working hard to obtain external funding to substitute for some of this state support, contraction at the federal level presents us with what has been described as a Perfect Storm, which has the potential to severely impact the land grant mission of supporting agricultural industries in the state and region. Special state allocations in the Biomass area and programs at the federal level have helped buffer the research funding in this target area but, partly because of our short growing season, there are some fundamental constraints on development of large scale bioenergy crops in the region.

V(I). Planned Program (Evaluation Studies and Data Collection)

Evaluation Results

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 22

1. Name of the Planned Program

Childhood Obesity

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
607	Consumer Economics			60%	
701	Nutrient Composition of Food			40%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Actual	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

V(D). Planned Program (Activity)

1. Brief description of the Activity

Because the work reported for 2010 in the annual review of the older Planned Programs includes effort that will be duplicated by also reporting under the newly mandated goals, quantitation of effort is not included under Inputs. However, we estimate that about 1% of Hatch expenditures were in this area.

While our researchers put considerable effort into quantifying the qualities of the agricultural commodities they support, including those like nutrient content, sensory qualities, processing qualities, etc., the ARC directly supports little scientific research that directly addresses issues related to human obesity although projects are planned for the future. Faculty members in Human Development are involved in research and outreach regarding the prevention of child obesity. One project, supported by a USDA grant, is a collaboration with nursing school faculty on the implementation and evaluation of a school-based obesity prevention program for adolescents in the Spokane schools. In collaboration with colleagues at the Children's Nutrition Center in Houston, Temple, the University of Colorado at Denver, and North Caroline State University, other projects study parent-child feeding styles, self-regulation in eating and non-eating domains, and the relationship of these behaviors to child obesity. Additional efforts in this area are being carried out by Extension faculty and will be reported jointly in the future.
.

2. Brief description of the target audience

Specialists interested in the relationship of childhood behavior patterns and the development of obesity and other food-related pathologies. As this approach reaches some consensus, it will likely involve the extension of school-based and parenting education programs that will implement important findings. Since this is a public health issue, the public will ultimately need to be engaged in order to move toward solutions.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2010
Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	0	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- {No Data Entered}

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

Outcome #1

1. **Outcome Measures**

{No Data Entered}

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

Changes in funding patterns have affected all research programs at the university but especially worrying is the serious decline in state funding that can be reallocated at the level of the Agricultural Research Center. This trend is likely to continue for at least another two years and will have significant consequences for the strength of our research programs. While or faculty have been working hard to obtain external funding to substitute for some of this state support, contraction at the federal level presents us with what has been described as a Perfect Storm, which has the potential to severely impact the land grant mission of supporting agricultural industries in the state and region.

V(I). Planned Program (Evaluation Studies and Data Collection)

Evaluation Results

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 23

1. Name of the Planned Program

Food Safety

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
307	Animal Management Systems			20%	
315	Animal Welfare/Well-Being and Protection			5%	
504	Home and Commercial Food Service			5%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources			10%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins			50%	
723	Hazards to Human Health and Safety			10%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Actual	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

V(D). Planned Program (Activity)

1. Brief description of the Activity

Because the work reported for 2010 in the annual review of the older Planned Programs includes effort that will be duplicated by also reporting under the newly mandated goals, quantitation of effort is not included under Inputs. However, we estimate that about 4% of Hatch expenditures were in this area.

Research in the area of Food Safety has focused primarily on microbiological contamination but has also included research and technical ability to determine chemical contamination of food. Work carried out in the WSU College of Veterinary Medicine has concentrated on learning the dynamics of highly pathogenic E. coli and S. typhimurium bacteria in animal production systems, especially related to cattle, and has included epidemiological studies to measure the prevalence and population biology of pathogens in different dairy and beef cattle operations, with a special focus on the transmission and persistence of antibiotic resistance traits. Research on bovine mastitis is also included in this effort, in an attempt to deal more effectively with infective Staphylococcus and a newly emerging Mycobacterium problem. At the level of the introduction of pathogens into the food supply, we are investigating how these bacteria might be introduced into field crops and developing faster methods for detecting pathogens on vegetables and in processed foods like cheese. This has included experiments to reexamine the ability of pathogens to survive composting conditions used to convert animal waste into manure. In addition, several groups are investigating methods for decontaminating or decreasing numbers of viable pathogens using methods including microwave irradiation, chemical washes, and cold plasma technology. In association with IR-4 certification support programs, we also test levels of chemical contamination and pesticide and herbicide residues in food.

2. Brief description of the target audience

For the researchers, the initial audience is other researchers who can validate and test how robust the results are. The ultimate audience is some mixture of producers and processors, regulators who attempt to balance the costs of procedures and their efficacy and applicability, and ultimately, the people who consume the food and are trying not to risk their health in doing so.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	{NO DATA	{NO DATA	{NO DATA	{NO DATA

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2010

Actual: {No Data

Patents listed
{No Data Entered}

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	{No Data Entered}	{No Data Entered}	{No Data Entered}

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- {No Data Entered}

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

Outcome #1

1. **Outcome Measures**

{No Data Entered}

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

Changes in funding patterns have affected all research programs at the university but especially worrying is the serious decline in state funding that can be reallocated at the level of the Agricultural Research Center. This trend is likely to continue for at least another two years and will have significant consequences for the strength of our research programs. While or faculty have been working hard to obtain external funding to substitute for some of this state support, contraction at the federal level presents us with what has been described as a Perfect Storm, which has the potential to severely impact the land grant mission of supporting agricultural industries in the state and region.

V(I). Planned Program (Evaluation Studies and Data Collection)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}