Brief summaries of funded projects for the FY 2008 Emerging Research Issues Internal Competitive Grants Program.

Summaries are extracted from portions of the funded proposals. Complete funded proposals are available upon request to the ARC.

Title: Cover Crops to Enhance Soil Productivity and Nitrogen Management in Organic and Transition Vegetable Production Systems

PI: Craig Cogger, Crop and Soil Sciences, WWREC
Cooperators: Ann-Marie Fortuna, Ann Kennedy, Andy Bary, Kate Painter, Bee Cha

Emerging Issues addressed: 2. Retention and enhancement of soil productivity. 4. Transitioning from conventional to organic production systems. 7. Agricultural practices at the urban-rural interface.

Significance: Cover crops provide multiple benefits to enhance soil productivity, and are especially well suited to the urban-rural interface, where there are heightened concerns about agricultural runoff and odors. Despite these benefits, farmer acceptance of cover crops often hinges on providing an economically valuable "keystone" service, such as N supply (Cherr et al., 2006). Quantifying and refining our ability to predict N supply under local conditions is a key to increasing adoption of cover cropping into organic and transition vegetable production systems in western Washington.

Objectives:
1. Quantify the N contribution of fall-planted hairy vetch and rye-vetch blend cover crops in an organic transition vegetable crop rotation, and assess the timing of N availability.
2. Compare the N contribution of summer-inter-seeded hairy vetch with a fall-planted rye-hairy vetch blend in an organic transition vegetable production system.
3. Develop practical guidelines for estimating the N contribution of cover crops in organic and transitional vegetable production.

Amount for FY 2007 = $16,291

= = = = =

Title: Development of crops for alternative cropping systems in Eastern Washington

PI: Scot Hulbert, Plant Pathology
Cooperators: Kim Campbell, Dan Skinner, Richard Johnson, Kevin McPhee, Hans Kok

Emerging Issues being addressed: The proposed research fits two of the topics (#2 and #6) mentioned in the RFP under the 'sustainable food and agricultural production systems' category: Retention and enhancement of soil productivity and water and air environmental quality as part of sustainable agricultural production systems.

Significance: This proposal is focused on improving sustainability of wheat-based cropping systems by adapting wheat and potential rotation crops to environments aimed at reducing soil erosion; in the process we will begin to associate markers with these abiotic stress tolerance traits to improve subsequent breeding strategies. Marker assisted selection is not currently feasible for drought or cold tolerance in wheat, safflower or the cool season legumes because genes controlling these traits have not been well-associated with markers.

Objectives:
1) Identify QTL responsible for winter hardiness in pea that can be used to develop edible quality pea lines with the ability to survive harsh winter conditions.
2) Develop winter hardy safflower lines with improved oil percent and quality for rotation systems with wheat. The safflower populations will also be used for associating markers with winter hardiness and other important traits.
3) Construct several wheat QTL mapping populations for analysis of drought and cold tolerance. An outcome of this work will be the development of spring and facultative wheat lines that yield well under drought conditions and can be annually cropped or planted whenever moisture is sufficient.

Amount for FY 2007 = $19,286

= = = = =

Title: Influence of Nitrogen Fertility on the Susceptibility of Rhododendrons to *Phytophthora ramorum*

PI: Rita Hummel, Horticulture, WWREC
Cooperators: Gary Chastagner, Norm Dart

Emerging Issues addressed: 1. Development and implementation of integrated pest management in irrigated agricultural systems

Significance:
The exotic plant pathogen *Phytophthora ramorum* causes sudden oak death, a disease that has killed over a million oak trees in California and caused millions of dollars in losses to the nursery industry in California, Oregon, and Washington (6, 7, 12). Since 2000-2002, when scientists first demonstrated that the spread of *P. ramorum* was associated with the movement of nursery-stock.

We are proposed to use the *P. ramorum*-rhododendron pathosystem as a model to investigate the dynamics between nitrogen application rates and the potential for disease develop and dispersal and specifically to test the hypothesis that higher nitrogen fertility results in increased disease and sporulation of this pathogen. *P. ramorum* is the model organism of choice since it is the driving force behind current BMP reforms and no information is available on the effects of nitrogen fertility on disease and sporulation for this particular pathogen. Rhododendron is the most logical model plant to use in pathological studies of *P. ramorum* since Rhododendron spp. Account for almost 90% of the plants associated with positive nursery finds in Washington state

(4). Rhododendron species and hybrids are also the most important hosts of *P. ramorum* in Europe.

Objectives: Determine the effect of nitrogen fertilization on the susceptibility of rhododendron cultivars to *P. ramorum.*

Amount for FY 2007 = $10,537
= = = = =

Title: Genomically Standardized Farming for High-Quality Beef to Benefit Washington Agriculture and Human Health

PIs: Zhihua Jiang, Animal Sciences; Raymond Wright, Animal Sciences; Karen Killinger, Food Science and Human Nutrition

Emerging issues addressed: 9. Consumer preferences and acceptance of evolving biotechnologies and functional foods aimed at improving health and nutrition.

Significance: Eating healthy or eating right is a popular topic of our everyday life, which reminds people of maintaining a healthy body weight, enhancing general wellbeing and reducing the risk of a number of diseases including heart disease, stroke, cancer and diabetes. *The significance of the proposed research is, therefore, to produce a beef that is healthy but yet flavorful for consumers and develop a niche product for producers.* Our proposed research on genomically standardized farming would help close three gaps among scientists, producers and consumers, including a gap between *producers* and *consumers* on how producers can use genomic technology to adjust their breeding program and produce products to meet consumers' need for healthy foods; a gap between *scientists* and *producers* on how scientists can transfer genomic discovery from the laboratory to on-farm applications and a gap between *scientists* and *consumers* on how scientists can convince consumers to accept the genomically standardized animal products.

Objectives:
Our proposed system on genomically standardized farming involves: 1) collection of both oocytes and sperm for reproductive laboratories to produce thousands of embryos; 2) determination of genotypes on each embryo for genomic laboratory selection of those that have potentials to produce healthy products for consumers; 3) transplantation of these selected embryos to host animals for producers to generate breeding stock for a large scale production of healthy food later and 4) public promotion of the genomically standardized products for consumers to accept them.

Amount for FY 2007 = $58,138

= = = = =

Title: A Needs Assessment for Washington Conventional and Organic Produce Growers: Food Safety Awareness and Use of Management Practices Promoting Safety of Washington Produce

PI: Karen Killinger, Food Science and Human Nutrition
Cooperators: Andy Bary, Craig Cogger, Richard Dougherty, Jessica Goldberger, Joe Harrison, Carol Miles

Emerging Issues addressed: 4. Transitioning from conventional to organic production systems and 11. Production, marketing, and distribution systems in support of emerging regional and local food systems.

Significance: The research is significant because it would provide data to identify the most important producer needs for the state of Washington that must be addressed with applied research and outreach programs and produce a validated assessment tool that can be utilized in subsequent years to maintain knowledge of producer needs and practices. Furthermore, an assessment of compost safety will provide critical data to evaluate the safety of an important nutrient source utilized by Washington crop producers. Finally, increasing contact with produce growers regarding food safety awareness is an important outcome for this emerging Washington issue.

Objectives:
1. Conduct a producer needs assessment to identify common practices for conventional and organic management systems and fields in transition as well as producer knowledge of food safety issues and regulations.
2. Determine food safety of manure-based compost by assessing for pathogens, quantifying indicator organisms and performing a field comparison of conventional and organic fields.
3. Conduct extension programs to increase producer awareness of food safety, on-farm practices affecting food safety and regulations relating to food safety.

Amount for FY 2007 = $39,203

= = = = =

Title: A Sustainable Agricultural Approach to Improve Water Quality and Reduce Foodborne Pathogens in Fresh Water Resources Using Vegetative Filter Strips

PI: Karen Killinger, Food Science and Human Nutrition
Cooperators: Jeffrey Ullman, Joe Harrison

Emerging Issues addressed: 6. Water and air environmental quality as part of sustainable agricultural production systems.

Significance: The proposed research and outreach is significant as it will further elucidate required parameters for vegetative filter strips to reduce pathogen run-off and improve water

quality. Furthermore, increased producer implementation of this sustainable best management practice is a significant outcome of this study.

Objectives:

1) Evaluate the effectiveness of vegetative filter strips as a best management practice to reduce pathogen run-off and improve water quality at a concentrated animal feeding operation that borders an irrigation ditch and the Yakima River within the Yakima River Watershed.
2) Assess pathogen presence and microbial water quality in the Yakima River Watershed by testing for the presence of *E. coli* O157:H7 and *Salmonella* spp. And enumerating total and fecal coliforms as well as generic *E. coli*.
3) Perform outreach activities to increase water quality awareness and adoption of best management strategies to improve water quality within the Yakima River Watershed.

Amount for FY 2007 = $52,222

= = = = =

Title: Differentiating Washington Produce by Profiling Phytochemicals Related to Human Health

PI: B. Markus Lange, Institute of Biological Chemistry
Cooperators: John Reganold, Preston Andrews

Emerging Issues addressed: 9. Consumer preferences and acceptance of evolving biotechnologies and functional foods aimed at improving health and nutrition

Significance:

Objectives: The overall goal of this project is to develop new high-throughput analytical methods to measure the levels of health-related phytochemicals and to apply these techniques to evaluate if claims can be made that the consumption of Washington produce provides added health benefits to consumers. This pilot study can be expanded to assess, on a larger scale, if there is a scientific basis for branding Washington produce as superior to that of competing states or countries. The specific goals of the proposed activities in year one of the study are the following:
(**1**) Develop novel high-throughput protocols for measuring the levels of relevant health-related phytochemicals in tree fruits and vegetables. These efforts are made possible by the recent acquisition of high end bioanalytical instruments using funds from the Institute of Biological Chemistry, the Agricultural Research Center and the M.J. Murdock Charitable Trust. The major advance expected from this work is the development of techniques that will allow us to obtain profiles covering all major health-related phytochemcials in a single chromatographic run, thus reducing the time, effort, and cost of evaluating crop quality.
(**2**) Determine the levels of health-related phytochemicals in four major Washington crops (apples, sweet cherries, raspberries and potatoes) and compare these values to those obtained from the same commercial crops grown in California. The key question is: Does Washington

produce contain more health-promoting and less anti-nutritional phytochemicals than that grown in California?

Amount for FY 2007 = $83,241

= = = = =

Title: An Autonomous Application System for Targeted Pest Control

PIs: F. J. Pierce, Center for Precision Agricultural Systems; M. Kise, Center for Precision Agricultural Systems; D. B. Walsh, Entomology/IAREC; J. Chang, WSU Tri-Cities/Mechanical Engineering

Emerging Issues addressed: 5. Automation and mechanization to enhance the efficiency, safety, and economic sustainability of food production and processing systems; and 1. Development and implementation of integrated pest management in irrigated agricultural systems

Significance:

Objectives:
Our major objective is to develop and demonstrate an autonomous application system for targeted pest control designed specifically to improve barrier applications for cutworm control in grapes as a model for other pests in other crops. The system will include a vision system for target recognition and assessment and pest control material application technologies that either 1) improve application accuracy for the current pyrethroid barrier application, 2) applies a uniform application of hot pepper wax to the grape trunk as an organic control alternative, or 3) installs a physical barrier on the trunk consisting either of a band or a wrap treated with pyrethroid or hot pepper wax, respectively. A sub-objective will be to conduct preliminary field experiments to assess the efficacy of items all three pest control methods using manual application in year 1 and 2, with a comparative assessment of manual versus autonomous application in year 2.

Amount for FY 2007 = $57,607

= = = = =

Title: Adding Values to Agricultural Commodities Produced in the State of Washington: A Multidisciplinary Approach

PI: Juming Tang, Biological Systems Engineering
Cooperators: Yulin Ji, Shyam Sablani, Boon Chew, Barry Swanson, Joe Powers, Jinwen Zhang

Emerging Issues addressed: 9. Consumer preferences and acceptance of evolving biotechnologies and functional foods aimed at improving health and nutrition; and10. Improving farm profitability through new uses of crops, livestock, and byproducts

Significance:

Objectives:
The general goal of this proposal is to initiate research activities that bridge the gap between food processing and human nutrition in studying the influence of food processing operations on health-related functional properties in major agricultural commodities produced in the state of Washington. This will build a strong platform to attract state and federal funding to enhance and expand our multidisciplinary research and graduate education for the benefit of the state economy and the health of its citizens. In order to achieve measurable outcomes within a two year period that will allow the team to attract state and federal supports, we have chosen to focus on studying the influence of two main food processing unit operations, novel drying and extrusion technologies. These technologies have broad applications for agricultural products produced in the state of Washington. We will later extend our efforts to other unit operations, including novel thermal processing, extraction and separation technologies.

Objectives:
Specific objectives are: 1) to study the influence of selected novel processing technologies on functional properties that directly influence consumer health: glycemic index from different starch sources (e.g., potato, legumes) and antioxidant activities from colored potato (crops of great interest to WA farmers) and from small fruits and grapes; and 2) to gather scientific and engineering information and develop unique and economical viable processes for production of consumer acceptable products with increased retention of healthy promoting functional activities for both high risk populations (children, senior citizens) and the general population.

Amount for FY 2007 = $64,387

= = = = =

Title: Preparing Washington State Forage Producers for Pest Management and Agronomic Impacts of Long-Term Drought and Climatic Change

PI: Douglas Walsh, Entomology, IAREC
Cooperators: R. Troy Peters, Rick Boydston

Emerging Issues addressed: 1. Development and implementation of integrated pest management in irrigated agricultural systems and 3. Improving water use efficiency

Significance:
Climate models predict increased winter precipitation. When followed by summer droughts, this combines to increase winter annual weed competition with crops. Increased winter annual weed density will in turn increase the populations of pest insects that use weeds as overwintering hosts.

Forage crops are especially vulnerable to water shortage. The research and extension project we propose would assess agronomic and pest management challenges water shortage would impose on producers of forage crops alfalfa and timothy hay. Forages are the third most valuable crop produced in the United States. Forages are the #4-ranked crop in Washington, and Washington ranks as the nation's 15th state in the production of forages (NAFA 2006). Nearly three-quarter million acres of various types of hay were harvested in Washington in 2006, with a combined value of $367 million (WASS 2006). Forage is a major input for Washington State's $1.5 billion livestock and dairy industries.

Objectives:
Our proposal addresses the agronomic and pest management implication of drought in grass and legume forage crops. What we learn about drought/deficit-irrigation pest management will be applicable to crops outside the forage group including mint, grains (wheat, barley, oats, corn), and the high-value vegetable and seed crops so important to our state's economy.

Our primary research objective is to determine the short and long-term pest management challenges associated with reduced water availability via the following steps:

- creation of simulated water-deficit situations through the engineering and construction of a controlled line-source sprinkler experiment and through commercial-scale experiments on center-pivot irrigation systems.
- application of reduced-risk weed and arthropod control techniques to subject crops at each of the varying water levels in our experimental plots and fields,
- Assessment of various methods of pest control at varying irrigation levels,
- Development of recommendation for reduced-risk integrated pest management at varying levels of water availability, and
- Dissemination of this information via multiple practical means as described in the "Extension Plan" section.

Amount for FY 2007 = $62,369

= = = = =

Title: High-Value Crops under High Tunnels in Western Washington

PIs: Thomas Walters, Horticulture and Landscape Architecture/Mt Vernon; Carol Miles, Horticulture and Landscape Architecture/Mt Vernon
Cooperators: Debra Inglis, Lynell Tanigoshi, Tim Miller, Craig MacConnell, Don McMoran

Emerging Issues addressed: 7. Agricultural practices at the urban-rural interface; 11. Production, marketing, and distribution systems in support of emerging regional and local food systems; and 4. Transitioning from conventional to organic production systems

Significance:

High tunnels (unheated, three-season structures with open ends) offer a means to greatly enhance crop values by extending the production season, increasing the range of crops which can be successfully grown, and easing the transition to high-value organic production. High tunnels have become widely adopted in other food growing regions such as the United Kingdom, California, Spain and Portugal (Gaskell, 2004; Knight, 2002).

Western Washington's mild, marine climate is ideal for tunnels. Crop productivity, marketability and diversity could be greatly enhanced with the additional daytime heat units and rain protection they provide. However, high tunnel research in our region has not kept up with the pace occurring worldwide. Information gaps include:

1) Will high tunnels facilitate adoption of high-value production systems in Western Washington?
2) Will high tunnels remove pest management barriers to organic production?
3) Which cropping systems will maximize profitability over a year?

Objectives:

1) Adapt high-value vegetable and fruit tunnel production systems to western Washignton.
2) Determine the value of protected structures as a tool for Integrated Pest Management and for transition to organic production
3) Assign a value to crops produced from identified systems and determine totoal system return on investment.

Amount for FY 2007 = $46,323

= = = = =

Title: Investigation of Starch-Based Polycarboxylic Acids as Curing Agents for Waterborne Epoxy Adhesives and Crosslinker for Cellulose

PIs: Jinwen Zhang, Wood Materials and Engineering Laboratory; Ming Xian, Chemistry; Vikram Yadama, Wood Materials and Engineering Laboratory

Emerging Issues addressed: 9. Consumer preferences and acceptance of evolving biotechnologies and functional foods aimed at improving health and nutrition

Significance:

Objectives:

The *long term goal* of the proposed research is to develop economically viable and environmentally sound formaldehyde- and amine-free alternatives from renewable resources to petrochemical adhesives and impregnating polymers. Specially, the *objective of this application* is to investigate the preparation method of SPCA and the structure-curing kinetics-property relationship of the SPCA/waterborne epoxy system. The *central hypothesis* of the application is that SPCA can function as a water soluble curing agent for waterborne epoxy adhesives and as an effective impregnating material, and that the properties of the cured resin can be manipulated

by controlling the molecular weight and functionality of SPCA. The *rationale* for the proposed research is that once it is known how the molecular weight and functionality of the SPCA influence the properties of the cured epoxy resin, new technologies of waterborne epoxy adhesives and impregnating systems can be developed based on renewable resources.
We plan to objectively test the central hypothesis and accomplish the object of this application by pursuing the following *specific aims*:
1) Manipulate the molecular weight and carboxylic content of SPCA.
The *working hypothesis* for this aim is that the molecular weight and carboxylic content can be largely controlled by fine-tuning the hydrolysis and oxidation conditions
2) Identify the structure-curing kinetics-property relationship of the SPCA-epoxy system.
The *working hypothesis* for this aim is that varying molecular weights and carboxylic contents of the SPCA will regulate the cross-linking density and network structure of the cured resins, hence resulting in different properties.
3) Develop and demonstrate applications for wood adhesives and impregnation for dimensional stability.
The *working hypothesis* for this aim is that SPCA can replace currently used adhesives such as UF and PF and successfully penetrate cell wall material in wood thus imparting dimensional stability to wood-based composites.

Amount for FY 2007 = $63,311