

**Report on
Annual Plan of Work Accomplishments**

for the

PLAN OF WORK

for the

**United States Department of Agriculture
Cooperative State Research, Education and Extension Service**

**Oregon State University
College of Agricultural Sciences
Oregon Agricultural Experiment Station**

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Federal Fiscal Year 2000

**September 30, 1999
To October 1, 2000**

Complete and Approved:

Dean & OAES Director

Date

Components of the 2000 Annual Report of Accomplishments and Results

A. Programs

1. National Goals and OSU Programs

The OAES POW programs were not submitted in 1999 on the basis of Key Themes for Planned Programs identified under each national goal.

The OAES programs are not categorized under one of the Key Themes, and our individual projects are so diversified that we cannot find a means to report on them under any logical title other than the programs that were devised in the POW.

This report is presented such that the Hatch and Multistate accomplishments and results are focused on the goals identified in OAES POW and in the FY 2001 CSREES Budget. These include biobased products program, advances in biotechnology to develop new agricultural products, small farms and their contributions to local economies, organic agriculture production and processing methods, improved pest control and Food Quality and Protection Act implementation, scientific basis for optimal health, modifying food intake behavior, the invasive species program, water quality, and sustainability of agriculture and forestry.

OSU Program Descriptions by CSREES Goals and OAES Programs (See item

1. OSU Program 1: Plant and animal improvement and new agricultural product development (USDA Goal 1)
2. OSU Program 2: Systems for Producing, Processing and Marketing of Agricultural Products (USDA Goal 1)
3. OSU Program 3: Safe and Effective Management of Pests (USDA Goal 1)
4. OSU Program 4: Food Safety and Quality (USDA Goal 2)
5. OSU Program 5: Human Health and Nutrition (USDA Goal 3)
6. OSU Program 6: Agriculture and Environmental Quality (USDA Goal 4)
7. OSU Program 7: Rural and Community Development (USDA Goal 5)

2. Overview

Accomplishments and Results for the year 2000.

OSU research has, and will continue to benefit a wide range of stakeholders including: disciplinary peers, federal and state policy makers, university administrators, rural community leaders, agricultural producers and commodity groups, and other state, regional, national and international interest groups with a stake in future of agriculture and Oregon's environment. The following summaries of research unit accomplishments are reported within the OSU program area where the activities are most highly focused.

1. OSU Program 1: Plant and animal improvement and new agricultural product development (USDA Goal 1)

Crop and Soil scientists have released new crop cultivars of wheats, barleys, potatoes, and meadowfoam over the past two years. These cultivars will generate hundreds of thousands if not millions of dollars in economic benefit to growers. They will expand existing markets and open new market opportunities in some cases. The improved disease resistance of some of these cultivars will have positive impacts on our environment, as fewer pesticides will be needed to control diseases. Genes have been mapped and introgressed which confer quantitative resistance to barley stripe rust. A new high-yielding soft white winter wheat cultivar with superior disease resistance was proposed for release as well as a hard white winter and a hard white spring wheat. The latter have great potential in domestic as well as Asian noodle markets. The barley varieties Orca, Tango, Kold, and Strider are released and commercial seed is available. The focus on a new market class – six-row winter malting barley – opens up new production and marketing options for Pacific Northwest growers. An array of genetic markers have been identified in sunflower and shared with cooperators around the world. Two new meadowfoam cultivars have been released and will be licensed. The first ever cuphea cultivar is ready for release. Several new cultivars of potatoes have been released with non-exclusive licensing being utilized. Umatilla Russet currently ranks 9th in the nation in potato seed production. The most noticeable outcome of the grass seed research activity has been the rapid decline in acres of grass seed crops annually open burned. For years, Willamette Valley grass seed growers burned their fields after harvest to control diseases, weeds and to stimulate new growth. Extensive research has demonstrated that selective types of non-thermal management of grass seed production is an acceptable replacement for open field burning for the major grass species grown in the Willamette Valley in terms of seed yield and stand life. Also, research has shown open field burning is still an important management tool, particularly for those species of grass that cannot be profitably produced without thermal sanitation.

The metabolism of the plant hormone cytokinin have been identified by horticultural scientists that contribute to our fundamental understanding of plant growth and development and will be powerful tools to modify plant development in the future. Other laboratories have identified genes important in plant stress, most recently, a gene enabling plants to withstand iron deficiency. Horticulture faculty members participated in the evaluation of advanced selections for recommendation for release to the industry. In the case of hazelnut, Oregon produces 99% of the U.S. crop. The breeding effort is solely based at OSU. Cooperative partnerships for developing molecular maps and markers have been developed through cooperation with the US Forest Service. Horticulture faculty partner with entomologists and plant pathologist at OSU and USDA to provide an integrated approach to developing sustainable production systems.

Animal reproductive physiology research in the bovine has been used to enhance estrus synchronization procedures that are being used today in production agriculture. Scientists are improving the understanding of the livestock system and are then applying those technologies to enhance the efficiency and sustainability of animal production in Oregon. Animal Scientists have discovered ways to utilize bunched hay and various livestock pasture rotations in various range cattle grazing areas to enhance efficiencies and greater profits. Studies have focused on the effects of rumen protein degradability and supplementation frequency on ruminant performance, nutrient utilization, and grazing behavior. Other research has included non-structural carbohydrate supplementation of ruminants grazing high-quality forage. Results suggest that infrequent supplementation (as infrequently as once every 6 days) of low-quality forage with protein ranging from 40 to 80% rumen degradable will yield results similar to daily supplementation for ruminant performance and overall nutrient utilization. Also, non-structural carbohydrate supplementation of ruminants consuming early season native flood meadow does not appear to provide economic or performance benefits. Research to date has evaluated using offstream water/salting, and, timing of grazing to encourage optimal distribution of cattle through the eastern Oregon pastures. In short, both offstream water/salt and early season of use was successful in decreasing proportion of time spent in riparian areas. In addition, both management strategies decreased use of the riparian area vegetation and increased use of upland vegetation. Avian sperm mobility research has resulted in development of a patent and adoption of this patented process that helps the industry to identify and eliminate low fertility sires.

The objective of the Pacific oyster broodstock management program and resource center for the West Coast oyster industry is to identify superior meat producing oysters. Two cohorts of about 100 families were produced and planted at four commercial test sites in partnership with industry. Top-performing

families with the highest meat yields were identified at harvest of a previously produced cohort planted at an inter-tidal and a sub-tidal site.

Agricultural economics research on productivity measures is responsible for many of the tools used in the profession to measure changes in productivity. The applied productivity work has been cited by the Secretary of Agriculture as crucial to understanding the linkages between R&D, competitiveness and trade.

2. OSU Program 2: Systems for Producing, Processing and Marketing of Agricultural Products (USDA Goal 1)

The Mid-Columbia Agricultural Research and Extension Center and the Mid-Columbia tree fruit industry places a strong emphasis on an Integrated Fruit Production (IFP) program which implements the continual development of growing, storing, packing, and marketing tree fruits from the Mid-Columbia region of Oregon and Washington. Accomplishments include non-chemical control of scald disorder on 'd'Anjou' pears, prediction of harvest maturity of pear crops and development of scald disorder of 'd'Anjou' pears by pre-harvest temperature, and induction of normal ripening capacity and enhancement of dessert qualities of 'd'Anjou' pears by ethylene treatment during early marketing season.

3. OSU Program 3: Safe and Effective Management of Pests (USDA Goal 1)

Microbiologists are engaged in research on infectious agents, i.e. viruses, bacteria, and parasites, of agriculturally important animals and plants. The ultimate aim of these studies is the design of a means to control these pathogens, either by vaccination or by interference with the pathogen replication using specific chemotherapeutants.

Microbiology faculty members have designed vaccines and chemotherapeutants to control different pathogens in fish and cattle as well as designing specific insecticides to control insect pests. Microbiology faculty have produced at least 20 publications in the year 1999-2000 on AES supported funds. There have been two patent filings, and two licensing agreements.

Botany and Plant Pathology faculty members are responsible both for fundamental and applied research in plant biology within agronomic systems at the molecular, cellular, organismal and population level. Microbial organisms studied have the potential for application in bioremediation. Segregation analysis has demonstrated that victorin sensitivity in Arabidopsis, as in oats, is controlled by a single dominant gene that we have tentatively named AVb. The discovery of victorin sensitivity in the model plant, *Arabidopsis thaliana* will facilitate a comprehensive genetical and molecular genetical evaluation of the victorin induced host response. Growers, research facilities that develop potato varieties, exporters and importers of seed and table stock potatoes, plant clinicians and diagnosticians worldwide will benefit from this technology. This system is both redundant (three specific DNA sites for verification of results) and absolutely specific for Cms. It will eliminate many possible errors in ascertaining the presence or absence of this pathogen in varietal seed development, the growing and selling of seed and table stock potatoes, and for research that monitors its dispersal and movement within infected plants. Research has found that seed borne late blight can be successfully managed with two tactics: seed treatment and a foliar fungicide at emergence. The objective of seed treatment with a product with activity against late blight is twofold: (1) to prevent transmission of the pathogen from the seed piece to the emerging plant and (2) to increase the overall stand and vigor of the planting. Maintenance of potato yields and quality in the Pacific Northwest often depends on the control Columbia root-knot nematode (*Meloidogyne chitwoodi*), stubby-root nematode (*Paratrichodorus allius*) the vector of tobacco rattle virus which causes corky ring spot (CRS) disease, and *Verticillium dahliae*, which contributes to early dying disease. These pathogens have been controlled by double fumigation with shank injection of 1,3-dichloropropene (1,3-D) at 20 gpa (which controls nematodes but not *V. dahliae*) plus metam sodium at 38 gpa applied via chemigation (which controls *V. dahliae* but not nematodes). Mixture of cultivars has been adopted in eastern Oregon for control of stripe rust on wheat and the possibility of similar application for control of Septoria can be considered.

The OSU crop science weed control research programs provided cost effective alternatives for troublesome weeds in row crops including cereals, alfalfa, onion, potatoes, corn, grass seed. This work was conducted in cooperation with the chemical companies and other weed scientists in Oregon, Washington and Idaho. Research

is being conducted to address the movement of genes between transgenic crops and weeds. We have studied introgression between jointed goatgrass, a weed, and wheat. It had been a commonly held belief that if the two species did cross, the plants would be sterile. We have shown in greenhouse and field studies that this is not the case and that viable seed are produced. We also have shown that self-fertility is restored in backcross generations. These are significant findings that have extremely important implications for the development of herbicide resistant wheat and the risk of resistance genes moving from wheat into a weed.

Alien weeds pose a major threat to rangelands of the Pacific Northwest. Their introduction and spread negatively impact human activity, wildlife populations, endangered species and watershed function. Rangeland scientists have had an active program in this area for the last 15 years and have worked on weeds and weed problems less formally for many years before that. The Oregon Department of Agriculture is heavily involved in using our new landscape ecology program to map and track weed infestations in Oregon.

The Treasure Valley Pest Alert Network Team in eastern Oregon was formed in 2000. Web page pest alerts for the area will be linked to pest life cycle, identification, and control information.

Dryland cereal producers in eastern Oregon have benefited economically from more effective weed and disease control strategies developed at OSU, as they have increased use of direct seeding technologies and more intensive cropping systems. The use of new, safer pesticides, integrated pest management strategies, reduced tillage seeding techniques, and improved nutrient management has reduced the potential for adverse effects on the environment. Agricultural sustainability in the dryland region has increased as growers have adopted these improved agronomic practices.

4. OSU Program 4: Food Safety and Quality (USDA Goal 2)

Research activities are underway to define the relationships between the molecular and functional properties of foods, which are critical to ensure effective formulation of new products that meet the specific health needs of U.S. consumers. Development of new analytical methods, natural antioxidant and antimicrobial agents, alternative processing techniques, and innovative food formulation is required to meet continuing demands for more nutritious, safer and better-tasting foods.

The storage life and quality of winter pears and apple fruit can be lengthened successfully by low oxygen storage. Currently the technology of low oxygen storage has been routinely applied by the fruit industry in the Pacific Northwest. The storage life and quality of winter pears and apple fruit has been lengthened successfully by low oxygen storage. The changes in extractable juice and water-soluble pectins in pear fruit after storage can be used as a predictive tool for storage life and fruit quality.

5. OSU Program 5: Human Health and Nutrition (USDA Goal 3)

OSU has been studying development of value added products in local fisheries and aquaculture operations including the albacore industry, Pacific whiting and oysters. Albacore landings have increased in Oregon over the past three to four years; however, most of the landed fish are destined for canning operations that are of minimal value. Several oyster companies are assisting in developing new products for the industry that would be especially appealing to younger consumers and also working with them in developing new technology of high pressure processing to improve safety and provide new market forms. The use of high pressure in oyster processing has developed a safer product with an extended shelf life. This has significant impact for the oyster industry both in the Pacific NW and the United States as it will result in a pathogen free oyster and provide the industry with a new processing method that can lead to new market product forms.

A novel approach to controlling unwanted microbial adhesion in a variety of clinical and industrial settings is to inhibit the initial attachment of bacteria, rather than trying to remove them once they have adhered. Our previous investigations have established that antimicrobial peptides such as nisin can adsorb to surfaces, and still retain sufficient activity to inhibit pathogenic bacteria. Since implant-associated infection is a common complication of catheterization, nisin was evaluated for its ability to prevent microbial adhesion on endotracheal suction catheters *in vitro*. Catheters in sheep pretreated with nisin for long-term placement (1-week) did not retain antimicrobial activity. However short-term airway studies using nisin-treated tracheotomy tubes in ponies demonstrated success against Gram-positive bacteria.

There were no abnormalities on clinical examination of sheep or ponies during the experimental period. This suggests that nisin-treated medical devices and implants could have potential as an added barrier to bacterial contamination in human surgeries.

6. OSU Program 6: Agriculture and Environmental Quality (USDA Goal 4)

OSU field station scientists wrote and posted explanations on the web of drip irrigation, fertilization, and irrigation practices to increase fertilizer and water use efficiency and protect water quality. We connected web sites so that daily estimates of crop water use by the BOR were automatically provided to interested growers through the 2000 growing season for Malheur County. The Treasure Valley Pest Alert Network Team was formed in 2000. Web page pest alerts will be linked to pest life cycle, identification, and control information.

Scientists in the Klamath basin prepared a Special Report for use by public agencies in determining TMDL's. Agricultural contributions to nutrient loading of surface waters appear to be much less than suggested in previous studies by other organizations.

OSU has been successful in identifying and developing nutrient management systems and tools to improve crop recovery of nitrogen and minimize leaching loss of nitrate-nitrogen from soil. Crops have included hops, corn silage, peppermint, wheat, and grass seed in the Willamette Valley. While growers benefit from lower production cost, all of Oregon's citizens benefit from groundwater protection from nitrate-N contamination.

We are investigating the molecular underpinnings of ammonia oxidation by bacteria. The genes that code for critical enzymes in this process are under investigation, including their regulation by ammonia. We have focused on the genes coding for hydroxylamine oxidoreductase. Three copies are present in *Nitrosomonas europaea*, and we have systematically disrupted one or two copies to reveal that only one copy is required for growth, and any one copy will suffice.

Development of models, datasets and tools are critical to watershed analysis and watershed restoration planning. EPA has funded the Pacific Northwest Ecosystems Research Consortium, a multiuniversity, multidisciplinary group developing alternative futures analyses for the Willamette river basin. The project is working with the Governor's Willamette Basin Initiative and Willamette Livability to Forum for increase or understanding of how different assumptions about growth management and policy development may affect ecological, hydrologic, economic and social processes in the Willamette Basin over the next fifty years. The results of this study are already being widely cited and currently used by decision-makers within the Willamette river basin.

Millions of hectares are threatened by wildfire in eastern Oregon every year. Western juniper currently occupies 2 million hectares in Oregon, and is still rapidly expanding its distribution. Juniper expansion and the lack of fire or too much fire across these semi-arid communities has dramatically changed plant and animal communities during the past 100 years across this semi-arid region. Results from OSU research have been used to develop fire management plans and guidelines for restoration of plant communities and wildlife habitat.

Agroforestry work is most often done cooperatively with colleagues in the Department of Forest Science as well as forest managers from the Bureau of Land Management and U.S. Forest Service. Agroforestry research efforts are coordinated with outreach programs of the OSU extension service, the Natural Resources Conservation Service, and the USDA National Agroforestry Center. Geographic information systems (GIS), and Global Positioning Systems (GPS) technologies have permitted widespread application of electronic mapping to land resource analysis. Rangeland Resources was the United States home of "Agroforestry Egypt," a multi-disciplinary cooperative effort of OSU and Alexandria University, Egypt funded by U.S. Agency for International Development during 1990-1995. Several different silvopastoral management systems have been developed and are being used in Oregon and around the world.

Fisheries and Wildlife scientists integrate research on natural resources across multiple scales. The department's research program is broad and diverse, and is applied to local, state, regional, national and international issues. Studies include human impacts on ecosystem components, function, and processes, including research programs that focus on vertebrate organisms, and substantial work focuses on biotic and abiotic factors that regulate populations and communities. The research is conducted in most ecosystems in the state including, wetland, stream, river, lake, forest, rangeland, agricultural and urban ecosystems.

The Malheur Experiment Station wrote and posted explanations on the web of drip irrigation, fertilization, and irrigation practices that are effective in increasing fertilizer and water use efficiency and protect water quality. Subsurface Drip Irrigation (SDI) management systems have been shown to allow highly productive crop production without leaching or runoff. Only the amount of water consumed by the crop need be diverted from a stream or reservoir, helping to protect stream water quality. Eventually, the growers will be able to cut in half N inputs for onions under SDI.

7. OSU Program 7: Rural and Community Development (USDA Goal 5)

The economic health of rural Oregon has declined markedly in the past few years elevating rural development concerns to the front burner for most rural communities. Current research in the department addresses three major components of rural development: 1) the economic role of agriculture in Oregon and the economic impact of agricultural production and processing on rural economies; 2) understanding the unique characteristics of rural poverty and evaluating the impact of state and federal policies on rural poverty; and 3) analyzing the structure of the state tax system and the distribution of tax burden among geographic areas of the state and across income classes.

3. Highlight successes/redirections that have resulted in significant change.

The programs' success has been reported in the Overview summary and in item 4 below in this report. There has been no redirection of OSU federally related programs since the POW was submitted in 1999.

4. Describe OSU assessment of accomplishments based on 5 Year POW and Document benefits to clientele

The OAES POW programs were not submitted in 1999 on the basis of Key Themes for Planned Programs identified under each national goal.

The OAES programs are not categorized under one of the Key Themes, and our individual projects are so diversified that we cannot find a means to report on them under any logical title other than the programs that were devised in the POW.

USDA Goals & OSU Program Description of Results

Research Impacts, Outcomes and Integration

USDA Goal 1 - Through research and education, empower the agricultural system with knowledge that will improve competitiveness in domestic production, processing, and marketing.

OSU Program 1: Plant and Animal Improvement and New Agricultural Product Development

Genetics and Breeding of Crops and Livestock:

Animal Sciences

Research programs in poultry genetics are active and ongoing. In addition, research in embryonic development and sperm mobility will lead to genetic selection that will enhance the efficiency of poultry and livestock production.

(1) Research Overview

Over the past 30 years or so, there has been growing social concern about the welfare of farm animals. These concerns have resulted in increased legislative restrictions on animal agriculture in Europe, most notably Sweden and Switzerland. These restrictions are intended primarily to ensure the physical and mental well being of the animals. The primary concern of consumers in these countries is that the animals should not be made to suffer, either physically or mentally in animal production systems. These same concerns are increasingly manifested in the US, creating a potentially explosive conflict between consumers and producers. So the overall objective of this study is to explore the perceptions which producers and consumers have about the mental capabilities (minds, thinking and intelligence) of domestic animals and whether or not these mental attributes should help to define acceptable animal production practices.

To accomplish these objectives, a mail survey will be sent to randomly selected households nationwide and to members of animal producer groups (National Pork Producers Council, United Egg Producers, and National Cattlemen's Beef Association). In addition, an identical survey will be conducted in Sweden, a country with 12 years of experience in revising farm animal production systems to comply with their Farm Animal Welfare Act. The results of this study, along with lessons learned from the Swedish experience, should help decision-makers, and animal and social scientists to design more socially acceptable animal production guidelines.

(2) Research Impacts

The research could help to change the US animal production model from intensive confinement systems to more open extensive systems. If that happens, the overall environmental consequences of the research will likely be positive, because it could result in less contamination of air and water by animal wastes.

The economic consequences are debatable. However, it is likely that a change from intensive confinement systems to extensive loose housing systems will result in increased production costs which would need to be assumed by the consumer in the form of higher food costs.

(3) Research Outcomes

If the research shows that there is high social concern about current confinement production systems, and if the research leads to a change to less confinement rearing of animals, the social consequences would be positive. People might feel positively about animal agriculture as a result of these changes.

The biggest impact would be on the US.

Davis, S.L., and P.R. Cheeke. 1998. Do domestic animals have minds and the ability to think? A provisional sample of opinions on the question. *J. Animal Sci.* 76:2072.

(4) Integrated Research

The paper cited above generated a tremendous amount of interest nationwide including radio talk show interviews, newspaper articles, agricultural publications like the Capital Press, the National Pork Producers Magazine, and Feedstuffs. Reports also appeared in the Oregon Scientist and in some children's magazines (example Contact Kids). Journal publications Books Trade publications Newspapers and magazines

(1) Research Overview

Genetic investigations continue to try and ascertain factors that influence the lethal developmental condition referred to as embryonic chick edema. As studies were progressing, a new embryonic failure has been identified in the SCWL dwarf chickens that results in a 25 % reduction in hatchability of fertile eggs. This condition is described as Ectopia Cordis. Affected embryos at 148 h of incubation are characterized by the presence of a reduced area vasculosa, unilateral microphthalmia, and situation of the heart out of the thoracic cavity. This condition is inherited as an autosomal recessive trait and the symbol, *ec* has been proposed for the gene. This condition, *ec*, is not similar to 3 previously described talpid disorders. The expression of *ec* is not influenced by breeder age nor length of pre-incubation egg storage.

Lesions resembling those observed in avian embryos with chick edema syndrome can also result from exposure to polyhalogenated compounds. Preliminary feeding trials have been conducted to assess the capability of a mannan oligosaccharide's ability to bind potential plant lectins in a poultry diet. The addition of a commercially available mannan oligosacchride, 3% (BioMos) to a starter ration containing exogenous plant lectins, 0.5% will ameliorate growth depression associated with lectins.

(2) Research Impacts

The identification of this new avian embryonic failure will allow the poultry breeder to eliminate carriers of this genetic disorder from their breeding foundation populations thus producing more cost efficient chicks with reduced losses due to genetic abnormalities. The identification of this new genetic disorder may also serve as an animal model in which to study ectopia cordis a condition that is also observed in human fetuses.

(3) Research Outcomes

The ability to add a naturally occurring substance such as a mannan oligosacchride to bind plant toxin materials in animal feeds has a unique potential to enhance animal performance. Increasing the growth rate and improving feed efficiency of animals on less than optimal feed sources would have economic benefit to the animal producer.

(4) Integrated Research - none

Agricultural and Resource Economics

(1) Research Overview

Purpose and Overview

The purpose of this study is to trace the origin of agricultural biotechnology patents back to the bioscience research (in universities, national labs, and institutes) on which the innovations were based as well as to the more immediate R&D expenditures more traditionally linked to these patents.

More generally, we are modeling the knowledge production process whereby scientists in the public and semi-public sectors share conceptual information with applied technologists, and in turn learn from them which conceptual approaches work best. The approach we take is to measure the relationship between biotech firms' productivity growth and the number and quality of biotech patents they are awarded. We then observe the scientific articles cited on these patents and trace the articles back to the institutions at which the authors worked. In this way we will observe, we believe for the first time, the complete set of linkages between university expenditures, basic scientific research, applied R&D expenditures, patented innovations, and productivity growth.

(2) & (3) Research Impacts and Outcomes

The research is in its early stages. We have identified all agricultural biotech patents awarded in the U.S. since the early 1980s, identified the names of the universities at which the science cited in those patents was conducted, and matched the names of those universities to the institutions included in the National Science Foundation (NSF) database of university research expenditures. We are now in the process of correlating the variables in the NSF and Patent Office databases.

(4) Integrated Research

Stakeholders who will be impacted by this research are university administrators and scientists, and commercial agricultural biotechnology firms.

Crop and Soil Science

(1) Research Overview

Development of high yielding barley varieties with unique quality profiles will contribute to profitable and sustainable farming. We are using genomics tools to locate genes determining quality, productivity, and stress resistance and molecular breeding tools to rapidly introgress these genes into adapted germplasm.

(2) Research Impacts

We are assembling a profile of the barley genome, based on multiple sources of germplasm, which will allow us to systematically achieve breeding objectives. Beneficiaries of this research will be farmers (higher net returns), processors (U.S.-grown barley), and consumers (safe foods and a quality environment).

(3) Research Outcomes

Genes have been mapped and introgressed which confer quantitative resistance to barley stripe rust. The varieties Orca, Tango, Kold, and Strider are released and commercial seed is available. The focus on a new market class – six-row winter malting barley – opens up new production and marketing options for Pacific Northwest growers.

(4) Integrated Research

The OSU Barley Program cooperates with all barley breeding and genetics programs in the U.S. and Canada. Internationally, the Program has strong ties with ICARDA/CIMMYT, the Scottish Crop Research Institute and the Institute for Bioresources (Okayama University).

(1) Research Overview

This research focuses on using genomic tools to locate genes determining oil quantity and quality, disease resistance, crop productivity, and other characteristics in oilseed crops including sunflower, meadowfoam and cuphea. Each of these crops is unique and with improved or modified oil or agronomic characteristics have the potential to create new cropping options and to open new markets or marketing opportunities for growers.

(2) Research Impacts

Research scientists have released nearly 600 markers to over 14 companies and institutes participating in the CARTISOL cooperative sunflower mapping effort. These markers are now in use by cooperators in at least 12 mapping populations. A group of downy mildew resistance genes has been identified and is being further analyzed. Oil and glucosinolate genetic analyses are underway in meadowfoam. Cuphea work continues to focus on development of a cultivar that can be machine planted and harvested. Release of a nearly non-shattering type is possible in the near future.

(3) Research Outcomes

An array of markers have been identified in sunflower and shared with cooperators around the world. Two new meadowfoam cultivars – Knowles and Wheeler – are in the process of release and licensing. The program continues to successfully train more than a half dozen graduate students and post doctoral candidates each year. The first ever cuphea cultivar is near release.

(4) Integrated Research

The OSU Oilseeds Breeding Program cooperates with both private companies and public institutions around the US and world. The program is an active member of the CARTISOL sunflower consortium, works with Syngenta, Pioneer, Procter and Gamble and other companies interested in oil products and has a long-standing relationship with USDA labs working in both the agronomics and oil quality of new crops.

(1) Research Overview

Development of high yielding wheat cultivars with unique quality characteristics contributes to profitable and sustainable farming. The wheat breeding program is using traditional breeding procedures and genomics tools to develop new cultivars with adaptation to unique climates or quality traits that will create new or capture existing wheat markets, both domestic and international.

(2) Research Impacts

This program directly affects growers across Oregon and the Pacific Northwest. Intensive efforts are underway to develop cultivars with performance stability across environments, improved disease and pest resistance that will result in less pesticide use and unique quality characteristics. Beneficiaries of this research will be farmers (higher net returns), processors (unique quality profiles for greater profitability and new product development), and consumers (safe foods and a quality environment).

(3) Research Outcomes

Over the past year a new high-yielding soft white winter wheat cultivar with superior disease resistance was proposed for release as well as a hard white winter and a hard white spring wheat. The latter have great potential in domestic as well as Asian noodle markets. Advanced lines with mutation-based genetic herbicide resistance are being moved into advanced testing.

(4) Integrated Research

The OSU Wheat Breeding Program cooperates with nearly all wheat breeding and genetics programs in the U.S. and has joint programs with CIMMYT – the international wheat breeding program in Mexico. The program has cooperative work with a number of private companies interested in herbicide resistant wheats and wheats with unique quality characteristics.

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(1) Research Overview

The Weed Science Program provides research on the management of weeds in agronomic and horticultural crops. Management strategies include chemical and nonchemical methods that will improve grower profitability with the goal of reducing environmental impact.

(2) & (3) Research Impacts and Outcomes

Research is being conducted to address the movement of genes between crops and weeds. It is an area of interest, nationally and internationally, for the production of transgenic crops. It is the study of evolution

under field conditions and addresses speciation. We have studied introgression between jointed goatgrass, a weed, and wheat. It had been a commonly held belief that if the two species did cross, the plants would be sterile. We have shown in greenhouse and field studies that this is not the case and that viable seed are produced. We also have shown that self-fertility is restored in backcross generations. These are significant findings that have extremely important implications for the development of herbicide resistant wheat and the risk of resistance genes moving from wheat into a weed. We have surveyed wheat fields in Oregon and have found hybrids under field conditions. Research was initiated to develop pest management strategies for irrigated row crop production that promote systems and biological diversity. Studies were established to evaluate the change in weed populations and the weed seed banks that occur with tillage rotation. Tillage rotations are implicit in most crop rotations, but often unrecognized as a unique rotational component. Our research demonstrated that early season weed emergence in snap beans and sweet corn can be reduced by 90 to 95% by planting through undisturbed cover crop residue and into untilled seedbeds.

(4) Integrated Research

This research has cooperative research studies with the University of Idaho and Washington State University as well as numerous private companies.

Horticulture

(1) Research Overview

Description. This program is designed to develop non-invasive methods to characterize and evaluate physiological and biochemical differences in diverse germplasm. These methods can be used to identify superior types in diverse populations.

(2) & (3) Research Impacts and Outcomes

Fluorescent spectroscopy methods have been developed to measure leaf photosynthetic efficiency in real time. A patent has been issued for this instrumentation.

(4) Integrated Research

Cooperation occurs with scientists at the University of Washington, University of Portland and Colorado State University,

(1) Research Overview

This research focuses on the development of new varieties of hazelnuts for Oregon. The major objective is the development of Eastern Filbert Blight (EFB) resistant varieties. In addition, varieties are being developed for the kernel market.

(2) & (3) Research Impacts and Outcomes

Two varieties, 'Lewis' and 'Clark' have been released. While not resistant to EFB, these two varieties have increased tolerance to the disease. Advanced selections of resistant lines based on single gene resistance are in advanced trials. Molecular markers for the resistance gene have been developed to improve the efficiency in selection of resistant plants in segregating populations. EFB resistant pollinizers have been developed and released to nurseries for use in existing orchards where highly EFB susceptible pollinizers are in use.

(4) Integrated Research

Cooperation in mapping and molecular marker development has occurred with the USDA Forest Service (Suacier, MS).

Genetic studies in vegetable crops

(1) Research Overview

The research centers on identifying and characterizing plant hormone genes and to determine their general function in plant development and specific influence in interspecific gene transfer of legumes.

(2) & (3) Research Impacts and Outcomes

A family of novel cytokinin genes, mediating the glycosylation of zeatin, have been identified and patent applications submitted. Targeted modification of plant traits is being investigated using transgenic technology. The impact on plant industry is anticipated to include improved growth habits, stress tolerance and yield.

(4) Integrated Research

National and international collaborative efforts with Pioneer Hi-Bred, Czech Academy of Sciences and Univ. of Antwerp

Testing and evaluation of berry crops for commercial production in the Pacific Northwest

(1) Research Overview

Involves cooperation with plant breeders in the Pacific Northwest in testing and developing commercially acceptable berry crop cultivars. Also, production systems are researched and the response of advanced selections and new releases to these systems is evaluated.

(2) & (3) Research Impacts and Outcomes

The following berry crop cultivars have been released in the last few years: 'Independence' and 'Firecracker' strawberry; 'Coho' and 'Lewis' red raspberry; 'Chandler' blueberry; and 'Siskiyou' and 'Black Butte' blackberry. All of these new cultivars are finding a place in the commercial industries, particularly in niche fresh markets. For some it is too early to document impact. However, 'Siskiyou' is planted for early season fresh market and commands a 40% premium price for its quality. Production research has shown that the new strawberry cultivars can maintain high yields with a 50% reduction in nitrogen fertilization.

(4) Integrated Research

Cooperators. ARS-USDA, Corvallis (Chad Finn), Dept. Food Science and Technology, OSU; Washington State University; Agriculture and Agri-Food, Canada, Agassiz, British Columbia, Canada.

Improvement of horticultural crops by biotechnology

(1) Research Overview

The research aims to develop unconventional methods for improving horticultural crops. The programs concern isolation of new genes of potential horticultural/agronomic importance and determining the effects of these genes on plant performance.

(2) & (3) Research Impacts and Outcomes

Tobacco plants (as a model system) containing the FRE1 and FRE2 genes (encoding Fe reductases) of yeast were tested for ability to withstand Fe-deficient conditions (high pH, bicarbonate). The FRE2-containing plants had enhanced Fe(III) reduction in roots and shoots, higher leaf Fe levels, and less leaf chlorosis under Fe-deficient conditions than the controls. Since about one-third of the arable land in the U.S.A. has low availability of Fe, the FRE2 gene can be used for improvement of a number of crops in regions having problems with Fe deficiency chlorosis.

A gene encoding an enzyme affecting the metabolism of the plant growth hormone cytokinin was studied with regard to its effects on plant development. The presence of the gene in tobacco caused increased adventitious root formation and lateral branching. This research contributes to our knowledge on the relationship between variations in individual cytokinin metabolites and plant development.

(4) Integrated Research

Collaboration with other states and countries (Belgium, Czech Republic)

(1) Research Overview

Variety trials were conducted with 22 different crops. The purpose of these trials was to test vegetable varieties for adaptation to Western Oregon. Breeding programs were continued for five crops (green beans, snap peas, broccoli, winter squash, and tomatoes). Additional screening trials or genetics work were also done with dry beans and sweet corn.

(2) & (3) Research Impacts and Outcomes

In beans, sources of resistance to white mold from scarlet runner bean were identified, and crosses were made to incorporate this resistance into common bean. In the green bean breeding program, elite lines were grown in five yield trials across the growing season. Best performing lines included OSU 5669 and OSU 5635, which may be released in the next year, and OSU 5643 and OSU 5819. Generally, we are seeking improved architecture and better quality in this program. With snap peas, the objective has been to develop stringless snap peas that perform well under stress conditions. We also initiated crosses to map the stringless gene. Broccoli trials of inbreds and hybrids were conducted to identify superior yielding lines. We now have hybrids with segmented, exerted heads suitable for processing that perform similarly to commercial hybrids. In winter squash, we have completed a second round of backcrossing to incorporate Zucchini mosaic virus resistance into the 'Golden Delicious' type. Another round of backcrossing will be needed to reach commercially acceptable type. The tomato cultivar 'Legend' was released from the vegetable breeding program. Legend is a large fruited fresh market type on a determinate vine. The cultivar also has limited late blight resistance. Head smut and root rot trials were also conducted on sweet corn. Work continues on popping beans.

(4) Integrated Research

Genetic engineering for stress tolerance in horticultural crops.

(1) Research Overview

We have transformed Arabidopsis with a bacterial gene for choline oxidase(codA), which converts choline into glycinebetaine. The transformed plants expressed this gene and accumulated glycinebetaine in the chloroplasts. We found that those glycinebetaine-accumulating transgenic plants are about 4 C hardier than the nontransformed plants.

(2) & (3) Research Impacts and Outcomes

The success in the model plant system led us to apply the same approach to tomato plants. We found that transgenic tomato plants are more tolerant to chilling and high salinity stress. Seeds from transgenic plants can germinated well even after prolonged chilling treatment, the nontransgenic seeds germinated poorly. Furthermore, seedlings of nontransgenic plants suffered severe injury after 4-8 days of chilling at 2 C, whereas the transgenic plants showed no visible damage and resumed growth rapidly upon returning to warm temperature. The transgenic seeds can germinate well under high salt condition (150 mM NaCl), whereas the germination of the wild type seeds were completely inhibited. Our results indicated that the transformation with codA gene enhance tolerance to both chilling and high salt stresses. As cold and salinity stress affect tomato production, cold and salinity tolerant tomato plants will increase the production of tomato under less favorable conditions.

(4) Integrated Research

Cooperation occurs with Japanese and Taiwanese scientists.

Botany and Plant Pathology

(1) Research Overview

Our research deals primarily with the basic aspects of the plant virus reproduction and spread. It has, however a practical significance mostly to the plant biotech industry and, potentially, to the development of antivirals targeting animal and human viral pathogens. Three major achievements of the last year were as follows.

- a) Relation between assembly of the virus particles and virus spread inside the infected plants. Understanding of these relations will help to develop novel approaches for virus control and to design more efficient modified viruses for production of the beneficial proteins in plants.
- b) Identification of the viral suppressor of the host defense response (RNA silencing). Utilization of this suppressor allows one to dramatically increase production of the desired proteins using transgenic plants or virus-derived gene expression vectors.
- c) Successful engineering of the chimeric viruses combining genes from the plant and animal viruses. This approach revealed novel information concerning the functions of viral genes and provided a powerful model system in which proteins from animal virus can be studied in plants (e.g., for development of antivirals).

(2) & (3) Research Impacts and Outcomes

Although there is no immediate economic benefits, our work increased potential utility of the plant viruses for the biotech industry resulting in the investment of ~\$100K for the next year by the Large Scale Biology Corp., CA, into our research.

(4) Integrated Research

Major collaborators include:

- a) Washington State University (J.C. Carrington, Viral suppressors of host defense)
- b) Large Scale Biology Corp., CA (virus vectors for protein production in plants)
- c) Leiden University Medical Center, the Netherlands (E.J. Snijder, chimeric viruses)
- d) Agriculture Research Organization, Israel (A. Gal-On, development of transgenic plants).

(1) Research Overview

A focus is to develop a novel DNA-based detection system for *Clavibacter michiganensis* subsp. *sepedonicus* (Cms), a worldwide, zero-tolerance bacterial pathogen that causes ring rot disease of potato. Three dispersed segments of the bacterial chromosome were identified that are unique to this pathogen, and DNA primers that prime the amplification of these DNA segments form the basis for the absolute specific detection of all Cms isolates worldwide. Field tests have been completed and the level of sensitivity of this system exceeds other methods of detection of Cms. The primers were modified to enable detection by fluorescent probes using TaqMan chemistry and Molecular Beacon chemistry which allows for greater simplicity, less ambiguity and potential for contamination, and high throughput. A patent (#5,710,002) "Detection of *Clavibacter michiganensis* subsp. *sepedonicus*" was issued covering this invention.

(2) Research Impacts

Growers, research facilities that develop potato varieties, exporters and importers of seed and table stock potatoes, plant clinicians and diagnosticians worldwide will benefit from this technology. This system is both redundant (three specific DNA sites for verification of results) and absolutely specific for Cms. It will eliminate many possible errors in ascertaining the presence or absence of this pathogen in varietal seed development, the growing and selling of seed and table stock potatoes, and for research that monitors its dispersal and movement within infected plants.

(3) Research Outcomes

The outcome of this research is currently being offered for commercialization to biotech companies that make and sell diagnostic kits.

(4) Integrated Research

The primers were made available to a USDA laboratory for analysis of efficacy. Working with the Plant Science Laboratory of the UK, this technology will be incorporated into the European Union Protocols for detection of Cms.

(1) Research Overview

Plant embryogenesis is governed by a complex network of developmental programs that are controlled genetically. My research goals are to identify genes that are critical for proper embryo development in maize. Embryo development has two distinct aspects: the establishment of the rudimentary plant body (morphogenesis), and the creation of a seed capable of desiccation and germination (maturation). We are studying both of these aspects of embryogenesis by isolating and characterizing mutants that disrupt embryo development in very specific ways. The current focus of our research into morphogenesis is on a set of three interacting genes whose function is required to form the embryonic shoot apical meristem the foundation of the future shoot system. With regard to maturation, we are focused on the antagonism

of two hormones, ABA and GA, in the regulation of genes required for storage product synthesis, desiccation tolerance, and suppression of pre-mature germination.

(2) & (3) Research Impacts and Outcomes

The research in my lab concerns basic science issues, so its immediate benefit is to other members of the plant science and genetics communities. Our results have been reported in the literature, in professional meeting presentations, and via our contributions to the Genbank and Maize DB databases.

(4) Integrated Research

Cooperation with other units, states, or other entities - We have had some collaborative research with individuals in OSU departments of Crop Science, Horticulture and Biochemistry.

Environmental and Molecular Toxicology

DNA Repair & DNA Damage Stimulated Homologous Recombination

(1) Research Overview

We are investigating DNA mismatch repair in plants using Arabidopsis as a model. A long-term goal is understanding how plants maintain genome stability in the face of persistent environmental mutagens such as solar UV-B light which appears to be increasing as a result of recent depletion of stratospheric ozone. Additionally, because mismatch repair antagonizes recombination between slightly diverged DNA sequences, understanding the function of specific proteins may allow progress toward homology-targeted gene insertion in plants. Finally, the infertility of interspecies hybrids may involve mismatch repair, as demonstrated for some other organisms

(2) Research Impacts

During the past year, we have identified Arabidopsis lines in which two mismatch repair genes, MLH1 and PMS2 are inactivated, and are identifying/constructing other mismatch-repair-defective lines, and lines deficient in other DNA-repair activities. We are developing transgenic plants that carry reporter genes that can be used in simple assays of genome stability, mutational reversion in this case. Also, we have demonstrated that UV-B damage to Arabidopsis chloroplast and mitochondrial DNA, as well as nuclear DNA, is repaired by enzymatic photoreactivation.

(3) Research Outcomes

Once they are characterized, plant lines deficient in specific mismatch repair genes, and plants incorporating mutation-reporter genes, will be further exploited in this laboratory, and will be made available to other plant scientists. Plant lines containing specific mutation-reporter genes and specific DNA-repair deficiencies will be used as bioindicators of specific environmental genotoxins.

(4) Integrated Research

Specific plant lines have been discovered in cooperation with scientists at the University of Wisconsin, Madison.

Central Oregon Agricultural Research and Extension Center

(1) Research Overview

The goal is to develop new potato cultivars adapted to the Pacific Northwest as part of a cooperative potato variety development program involving university, industry, and USDA personnel. Initiate and execute applied research on commercial and seed potato production problems in Central Oregon.

(2) Research Impacts

This research has impacted commercial and seed potato growers, potato processing companies and potato packer/shippers in the PNW.

(3) Research Outcomes

Umatilla Russet, a new potato cultivar, was released in 1999. Nearly 3400 acres of Umatilla Russet seed was produced in the U.S. (3176 acres) and Canada (206 acres) during the 2000 growing season. Umatilla Russet yields an average of 21% more U.S. No. 1s than Russet Burbank under approximately the same fertilizer regime, has 10% less hollow heart/brown center than Russet Burbank and is immune to net necrosis, a tuber flesh blemish caused by leafroll virus infection. Seed of Umatilla Russet is currently selling at a \$2.00/cwt premium to Russet Burbank, or a \$2.4 million gross increase in seed sales (\$259,000 for Oregon in 2001). Available seed can plant 60,000 acres during the 2001-growing season, replacing Russet Burbank acreage. Yield increases, one less pesticide application per year and internal quality improvements would result in additional gross sales increase of \$27.0 million over Russet Burbank (\$3.4 million for Oregon in 2001).

(4) Integrated Research

This program involves cooperation with scientists from other OSU departments, PNW universities and potato processors, and the ARS.

Hermiston Agricultural Research and Extension Center

Development of High Value Crop Production Technology for the Columbia Basin of Eastern Oregon

(1) Research Overview

Objectives: develop high-value crop production systems which maximize economic yield and quality and minimize detrimental environmental impact of crop production, through use of best-management practices for fertilization and irrigation, pest control, plastic mulches, row covers, windbreaks, etc., and plant stand establishment, including greenhouse transplant production techniques. Evaluate adaptation of commercial cultivars and breeding-lines of high-value crops that are, or may be, economically important in the region.

(2) & (3) Research Impacts and Outcomes

Programs underway in 2000 include:

- 1) Control of common smut of sweet corn in the Columbia basin. Evaluation of cultural and chemical methods of reducing common smut infection of sweet corn for processing (affects 80,000 acres in the Columbia basin).
- 2) Safety of herbicide application to sweet corn, potato and wheat for subsequent rotational crops, including onion (60,000 acres), sugar beet, garbanzo bean and condiment mustard.

- 3) Movement of genes by natural pollen transfer from genetically modified cantaloupe to wild, weedy relative.
- 4) Weed control efficacy and crop tolerance of several herbicides for onion.
- 5) Evaluate rate and application timing of several slow-release nitrogen fertilizers for fresh-market onions; determine impact on yield, quality, and storability, as well as determine nitrogen-use efficiency for selected treatment combinations.

(4) Integrated Research

Collaboration of research is with scientists at Oregon State University's Umatilla Extension Service and the Department of Botany and Plant Pathology. Industry cooperators include those from Collins Ag Consultants, Columbia Basin Processed Vegetable Council, Simplot Soil Builders, Helena Chemical Company, Hydro Agri N.A., DuPont Agricultural Products, Nelson Irrigation, Abbott & Cobb, Inc, Asgrow Seed Company, Crookham Company, Harris-Moran Seed Company, Novartis, and Exelixis Plant Sciences.

Development of New Crops Utilization of Conventional Plant and Animal Materials:

Crop and Soil Science

(1) Research Overview

U.S. farmers lack profitable crop alternatives to surplus commodities. Because of this, presently, there is a national and international economic crisis on family farms. This program supports meadowfoam development as a profitable new crop for the open enrollment Meadowfoam Oil Seed Grower Cooperative (OMG) members in Oregon. The focus is particularly as an alternative crop for annual ryegrass seed growers in the Willamette Valley on poorly drained soils where few alternative crops are available. Objectives are to develop and test improved cultivars and production practices to improve farm profitability and sustainability. Attention is given to facilitating farmer self-leadership development through direct farmer involvement in problem identification, prioritization, investigation, solution, and implementation.

(2) Research Impacts

Oregon farmers in OMG are the originators and world leaders in commercial meadowfoam oil production and worldwide marketing. The open enrollment grower cooperative corporation allows farmers to organize, and vertically integrate for economic and other efficiencies. It also provides a mechanism through which needed – but risky – new mindsets, new institutions, and new relationships can be forged. Their collaboration with this research has facilitated rapid change in meadowfoam production variables being researched in seedbeds, planting methods, planting dates, and associated management practices. This process, in an embryonic stage, seems to empower growers to be more efficient, more profitable, and more competitive.

(3) Research Outcomes

Collaborative on-farm research and development activities were conducted in the 1999- 2000 crop year. Farm-scale large (e.g. 62 acre) field production, and small replicated plot yield trials were conducted with an experimental genetic line developed in this research. Fields were carefully monitored and managed using the combined perspectives of the farmers and the researchers. The seed yield on the most closely managed field (62 acres) was one of the highest on OMG record. This has led to increased collaboration with OMG farmers.

(4) Integrated Research

Collaborative work on the objective of crop diversification to increase farm efficiency, profitability, and sustainability includes efforts with public and private researchers and other entities at Oregon State University, University of Missouri, Purdue University, University of Nebraska, Rutgers University, Montana State University, Iowa State University, as well as academics in Australia, Canada, and the United Kingdom.

Bioresource Engineering

(1) Research Overview

A novel approach to controlling unwanted microbial adhesion in a variety of clinical and industrial settings is to inhibit the initial attachment of bacteria, rather than trying to remove them once they have adhered.

(2) & (3) Research Impacts and Outcomes

Our previous investigations have established that antimicrobial peptides such as nisin can adsorb to surfaces, and still retain sufficient activity to inhibit pathogenic bacteria. Since implant-associated infection is a common complication of catheterization, nisin was evaluated for its ability to prevent microbial adhesion on endotracheal suction catheters in vitro. The success of this research prompted further studies in vivo evaluating nisin-treated intravascular catheters in sheep and tracheotomy tubes in ponies. This work was performed in close association with Dr. Jill Parker in the OSU College of Veterinary Medicine. Catheters pretreated with nisin for long-term placement (1-week) did not retain antimicrobial activity. However short-term airway studies using nisin-treated tracheotomy tubes in ponies demonstrated success against Gram-positive bacteria. There were no abnormalities on clinical examination of sheep or ponies during the experimental period. This suggests that nisin-treated medical devices and implants may have potential as an added barrier to bacterial contamination in human surgeries.

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OSU Program 2: Systems for Producing, Processing and Marketing of Agricultural Products

Integrated Livestock, Fishery, Plant. Range and Forest Systems

Agricultural and Resource Economics

Theory and Applications of Performance Measurement

(1) Research Overview

The purpose of this research is to (among others) incorporate undesirable outputs, bads, into the measurement of performance. Neglecting bads may bias the outcomes, e.g. the measurement of productivity. An application to U.S. agriculture demonstrates the case. More specifically, we show that the Törnquist index of productivity is biased upward when production of undesirable or bads are increasing. Conversely, this same measure of productivity is biased downwards when bads in production are decreased.

(2) Research Impacts

The model developed may become a tool used by other researchers in the area of productivity and externalities.

(3) Research Outcomes

The outcomes of this part of the research is summarized in the paper "Accounting for Bads in the Measurement of Productivity Growth," coauthored with E. Ball, S. Grosskopf, O. Zaim and R. Nehring.

(4) Integrated Research

(1) Research Overview

This research focuses on the technological link between production agriculture and food processing and its effects on the broader economy. It is motivated by the desire to address questions about the reasons for and effectiveness of publicly supported research, development and extension in agriculture.

(2) & (3) Research Impacts and Outcomes

This study clearly demonstrates that such investments, when translated into increased efficiency have several effects both within and outside of agriculture: (1) it raises the profitability of the primary sector (production agriculture); (2) it lowers the cost of agricultural inputs into processed food, allowing that sector to better compete in the global marketplace, where the structure of agricultural trade is shifting toward value-added products; and (3) the efficiency gains in agriculture and processed food sectors are passed on to consumers, both domestic and foreign, in the form of lower food prices. Thus, the study contributes to understanding the importance of supporting agricultural research, development and extension.

(4) Integrated Research

(1) Research Overview

My major research efforts at present are in the area of land valuation. My objectives are to better understand the factors that influence how farmland is valued. One area is linked to social capital, i.e., trying to understand how personal relationships influence the sale price for land. A second study examines the impact of land use laws on the value of farmlands, particularly those with existing home sites. Another paper used a similar approach to estimate the value of irrigation water.

(2) Research Impacts

There are a number of groups who benefit from this work. Other economists benefit by better understanding what factors should be considered when using hedonic models of farmland. Fee appraisers benefit by understanding how influential various factors are in land valuation. The state is currently evaluating the effectiveness of land use laws on maintaining EFU land. Individuals seeking to buy irrigation water for instream uses can better determine the market value of that water.

(3) Research Outcomes

To date, no significant changes have occurred in the state. The analysis dealing with land use laws may prove useful in considering changes. Tangentially, individuals from a farmland preservation group have taken interest in this work. They are interested in estimating the economic benefits of farm deferral assessments. They seek help in estimating the market value of farmland over the last 30 years, how that differs from assessed value, and the total tax savings that resulted. They hope to show that land use laws have not resulted in a "taking" of value, but that land owners have been compensated for the development restrictions on their land.

(4) Integrated Research

Some of the land valuation work was done jointly with a faculty member from Michigan State University. Other research efforts involve faculty from Texas A&M and Auburn.

Coastal Oregon Marine Experiment Station

Value-Added Seafood Product Research and Development

(1) Research Overview

The Pacific whiting fishery is a fully utilized fishery with 80% of the capture made into value added products such as surimi. Consequently, we have been looking at development of value added products in other local fisheries and aquaculture operations including the albacore industry and oysters. Albacore landings have increased in Oregon over the past three to four years, however, most of the landed fish are destined for canning operations which are of minimal value. We have begun looking at several value added products and improving the quality of the landed fish so that the industry can diversify and use their products for several market forms. The oyster industry is a traditional industry in Oregon and SE Washington and have a found a decreasing market share with their products of jar shucked oysters. We have been working with several oyster companies in developing new products for the industry that would be especially appealing to younger consumers and also working with them in developing new technology of high pressure processing to improve safety and provide new market forms.

(2) Research Impacts

The beneficiaries of local albacore fishermen and processors will see the greatest benefits from this research as the quality of onboard handling and storage of albacore improve fishermen will receive a higher ex-vessel price for their fish and processors will be able to develop new market niches for higher quality raw material. The development of new products in the oyster industry will assist the industry in directing their markets to new consumers especially the younger generation and allow them to develop new market niches at both the retail and wholesale lever. There has been an increasing concern about the safety of raw shellfish such as oysters. The use of high pressure in oyster processing has developed a safer product with an extended shelf life. This has significant impact for the oyster industry both in the Pacific NW and the United States as it will result in a pathogen free oyster and provide the industry with a new processing method that can lead to new market product forms.

(3) Research Outcomes

In the albacore fishery, there has been a marked improvement of onboard handling of practices and higher quality albacore that is landed. The next few years will determine whether these improved practices will increase ex-vessel prices for the fishermen. Work in the last six months has focused on product development and several new product forms are currently being evaluated by industry representatives. In the oyster industry, the OSU Seafood Lab and Nisbet Oyster Co. have developed the oyster shooter, which combines a shucked oyster with cocktail sauce in a shot glass that can be frozen and sold at the retail/wholesale level. This product has reached a reasonable level of commercial success in the West Coast and is currently being introduced throughout the US. Work with high pressure technology in the reduction of *Vibrio parahaemolyticus* has proven to be successful. This information is currently being evaluated by the US Food and Drug Administration for setting parameters of high pressure processing and its use in eliminating pathogens in raw oysters. Additional work with high pressure has demonstrated its utility in shucking oysters and its potential in developing new market products such as a shucked oyster in the shell that can be sold at the wholesale/retail level.

(4) Integrated Research

Research partners have included Dr. Gil Sylvia, in the Department of Resource Economics for the albacore program and Dr. Paul Reno in the Department of Microbiology in the oyster study with high pressure technology. Both the albacore study and oyster research have included industry partners in Oregon and the State of Washington

Broodstock Management and Breeding of Molluscan Shellfish

(1) Research Overview

The objective is to develop a Pacific oyster broodstock management program and resource center for the West Coast oyster industry.

Activities: In 2000, two additional cohorts of about 100 families were produced and planted at four commercial test sites in partnership with industry. Top-performing families with the highest meat yields were identified at harvest of a previously produced cohort planted at an inter-tidal and a sub-tidal site. Average yields of progeny derived from selected broodstock from top-performing families were between 8% (sub-tidal site) and 25% (inter-tidal site) greater than those of non-selected "wild" oyster broodstock. Furthermore, six out of the top ten performing families at each of the sub-tidal and inter-tidal sites were common to both sites, indicating that it should be possible to find "generalist" broodstock families that do well across a range of different commercial grow-out sites. Realized heritability values of 0.13 to 0.17 indicated that long-term selection should result in gradual, additional improvement of yields.

Selected broodstock from top-performing families were used in commercial hatcheries to produce seed for the West Coast industry and for a commercial-scale grow-out experiment. Methods for management and spawning of selected broodstock are being transferred to commercial hatcheries via personal visits and a web-based information site (<<http://www.hmsc.orst.edu/Projects/mbp/index.html>>). Industry is currently setting up its own broodstock repository for selected broodstock from this research.

(2) & (3) Research Impacts and Outcomes

The present annual dock-side value of Pacific oysters produced by the West Coast industry is \$69 million (Pacific Growers Shellfish Association, Olympia, WA). A 25% improvement in meat yield would represent about \$17 million in additional annual income for the industry. Annual Pacific oyster production in Oregon is valued at \$3.75 million (Pacific Growers Shellfish Association) and production could, therefore, be increased by about \$900,000, assuming a 25% improvement in yield as a result of using selected broodstock.

(4) Integrated Research

The program's objectives are complementary to those of the CSREES Special Project "The Molluscan Broodstock Program" (co-PI Mike Blouin, Dept. Zoology, OSU), a USDA-WRAC funded project "Improving Pacific Oyster Broodstocks" (co-PI's Dennis Hedgecock, U. California, Davis, Donal Manahan, U. Southern California, Joth Davis, Taylor Resources Inc.) as well as a USDA-funded Western Coordinating Committee (WCC-99) for "Broodstock management, genetics and breeding programs for molluscan shellfish".

Value-Added Processing for Fishery By-Products and Surimi Seafoods

(1) Research Overview

Activities

Two different approaches have been progressively made. One is physicochemical characterization of fish sauce developed from a mixture of Pacific whiting and its by-products. The other is to develop pasteurization methods for tastier products with microbiological safety.

(2) Research Impacts

Fish sauce program has demonstrated clearly for a positive use of fishery by-products by upgrading waste to human food. It is relatively still small market (16,000 M/T) in the US. But all are imported from Asian countries. The fish sauce manufacturing, which can be feasible in the States with a minimum of investment, could contribute something significant to the fishery industry. This market in the US has

grown by 10% every year. Pasteurization method for tastier surimi seafood with microbiological safety could enhance consumer safety significantly while providing fresh-like surimi seafood to consumers.

(3) Research Outcomes

Fish sauce manufacturing from fishery by-products would reduce/eliminate several million dollars of waste disposal and further diversify the nature of seafood processing.

(4) Integrated Research

I have been working with a microbiologist Mark Daeschel (OSU FST) for fish sauce and pasteurization.

Assessing the Status of Oregon's Groundfish Stocks

(1) Research Overview

The overall goal of this research program is to improve the accuracy of stock assessments that are used in the management of Oregon's fisheries for groundfish so that these fisheries can achieve greater economic benefits. During year 2000 work continued on evaluating the accuracy of stock assessment estimates produced by the Stock Synthesis computer program and evaluations were completed on using statistical model selection criteria with Stock Synthesis (Helu, Sampson and Yin, 2000). Work began on using long-term data on fish condition (weight versus length) collected from the commercial fish harvests to evaluate environmental forcing of the fish stocks.

(2) Research Impacts

The Federal and state governments spend considerable time and money collecting the data that are used for stock assessment. However, the various types of assessment data (e.g., catch biomass, age composition, weight at age, research trawl surveys) are not equivalent in how they affect the accuracy of assessment results. Evaluations of how the Stock Synthesis program transforms errors in the different data types will provide an objective basis for balancing the sampling effort allocated to the different data collection systems. Using model selection procedures in applications with Stock Synthesis will produce simpler stock assessment models and more accurate assessment estimates. Cost-effective data collection and improved model building will benefit the fishery agencies, the fishing industry, and the fish-consuming public.

(3) Research Outcomes

Because of concerns about data quality raised during a stock assessment prepared during 1999 (Sampson and Lee, 1999), the Oregon Department of Fish and Wildlife began a systematic review and overhaul of its groundfish data management systems.

(4) Integrated Research

Work for this program involves interaction with researchers from the Oregon Department of Fish and Wildlife and the Northwest Fisheries Science Center of the National Marine Fisheries Service. Stock assessments of U.S. West Coast fish stocks are prepared for and reviewed by the Pacific Fishery Management Council, which is the agency responsible for managing the regional marine fisheries, in cooperation with the state and Federal governments.

Marketing Issues Affecting the Oregon Seafood Industry: An Empirical Investigation

(1) Research Overview

This research was directed at achieving the objectives of supporting marketing and market development of U.S. and West coast seafood production and improving management of fisheries resources which impact market success. Specific activities included: 1) Improving management of the Pacific whiting fishery in order to improve product quality, product recovery, output price, and resource conservation. This effort required considerable data collection and analysis and development of comprehensive bioeconomic management models; 2) Developing strategies to reduce risk in seafood marketing and management through the development of portfolio models. A bioeconomic-based portfolio model was developed for the Pacific whiting fishery which included ten product forms and an integrated harvesting and processing sector; 3) Conducting marketing research on albacore tuna and Pacific whiting through marketing surveys which explored buyers' willingness to purchase based on improvements in product quality and handling

(2) Research Impacts

This research has significantly impacted the West coast whiting and albacore fisheries including fishermen, processors, and marketers. The results have also been used by the Pacific Fisheries Management Council to improve management of the Pacific whiting fishery.

(3) Research Outcomes

One specific outcome was adjustment of the harvest season opening for Pacific whiting in order to improve product quality and utilization. It has been estimated that this management change generated over \$10 million in direct industry benefits through improved product quality, recovery, and output price.

(4) Integrated Research

Collaborators have included the National Marine Fisheries Service, the Midwater Trawlers Cooperative, the New Zealand Seafood Council, and the Astoria Consumer Seafood Center

Bioresource Engineering

Decision Support System Development for Agriculture and Resource Management

(1) Research Overview

Research has focused on three main areas: 1) development of models, datasets and tools to watershed analysis and watershed restoration planning, 2) development of tools for ecological modeling, and 3) development of models and decision tools for pond aquaculture.

(2) & (3) & (4) Research Impacts and Outcomes and Integrated Research

1) Development of models, datasets and tools to watershed analysis and watershed restoration planning. There are several funded grants related to this area. One of these is funded through EPA via the Pacific Northwest Ecosystems Research Consortium, a multiuniversity, multidisciplinary group developing alternative futures analyses for the Willamette basin. The research consists of a cooperative effort between OSU (Fisheries and Wildlife, Bioresource Engineering, AREC, Geosciences, Forestry, and other departments), The University of Oregon, and the University of Washington, as well as EPA scientist in the Corvallis Lab. The group is working with the Governor's Willamette Basin Initiative and Willamette Livability to Forum for increase or understanding of how different assumptions about growth management and policy development may affect ecological, hydrologic, economic and social processes in the Willamette Basin over the next fifty years. The results of this study are being widely cited and used by decision makers within the Willamette.

A second major effort involves another multidisciplinary team (led by BRE, but including scientists from the departments of Geosciences, Fisheries and Wildlife, AREC, Entomology, and Sociology) to work with watershed councils in the Willamette Basin to develop analytical models and decision support tools to assist councils in understanding watershed function from multiple perspectives, and in developing restoration plans that are responses of landscape features, stakeholder priorities and ecological, economic, water quality/quantity, and social goals.

Additional efforts are focused on developing watershed-scale hydrologic models to assist in understanding the effects of land uses and channel functions on flow, watershed-scale distributed stream temperature and sediment transport models, and spatially explicit habitat evaluation models.

2) Development of tools for ecological modeling. We are pursuing, with funding from EPA, development of a series of software tools for developing next-generation, object-based, modular, distributed ecological and agricultural simulation models. This work is being done in cooperation with scientists in the OSU Computer Science department, as well as an international group of modelers located primarily in Wageningen University (The Netherlands). This will result in a suite of technologies that we anticipate will be widely used to increase the speed and efficacy of model development for analysis of ecological and agricultural systems.

3) Development of models and decision tools for pond aquaculture. This work represents several years worth of effort and funding to develop decision tools for managing aquacultural systems, identifying sites for establishment of new facilities, and optimizing existing production facilities. Funded through USAID, the primary client audience is international producers in developing countries, although we have had increasing interest from and contact with US-based aquacultural producers. The work has been done cooperatively with numerous international and domestic cooperators through the Pond Dynamics/Aquaculture CRSP program.

Postharvest Preservation, Storage, Handling and Transportation of Fresh Fruits and Vegetables

(1) Research Overview

Research activities during 2000 included:

Documentation and evaluation of three energy conservation management options in a commercial fruit storage warehouse.

Documentation of fruit mass loss in a commercial controlled atmosphere pear storage room subjected to three energy conservation management options.

Visual documentation of airflow patterns in a 1000 bin commercial fruit storage room filled with empty bins and with bins containing pears.

Visual documentation of airflow patterns in a 1/12th scale model of a 1000 bin commercial fruit storage room.

Model simulation of airflow patterns within a 1/12th scale model of a 1000 bin commercial fruit storage room using computational fluid dynamics.

(2) & (3) Research Impacts and Outcomes

Results of the research conducted in 2000 was presented at the 17th Annual Postharvest Conference and Trade Show held March 13 – 14, 2001 in Wenatchee, WA. This conference is attended by over 500 people each year and is sponsored by the Washington State Horticultural association and Washington State University. Energy conservation information presented at this conference documented energy

savings recorded during three modes of evaporator fan operation. Full fan operation (4 fans in one evaporator unit) used 1 kilowatt hour of electricity per bin per week. Simply turning off two fans reduced energy use to 0.5 kWh/bin/week and fan cycling at two hours on followed by two hours off reduced energy use to 0.26 kWh/bin/week. National Agricultural Statistic Service data reported that 8, 632,000 bins of apple and pear storage capacity existed in Oregon and Washington in 1999. Simply turning off half of the evaporator fans in the test room did not create that would adversely affect fruit quality. Therefore, potential energy savings of up to 4,300,000 kWh per week could be realized in Oregon and Washington by incorporating this management option when stable room conditions have been established. Fan cycling the two remaining fans on either a two hour on/two hour off or four hour on/four hour off basis moderately lowered room relative humidity and allowed slight increases in fruit temperatures in some parts of the test room. Depending upon the product being stored and the length of time fan cycling is performed; these changes may not be sufficient to cause measurable loss in fruit quality. Under this management option 6,470,000 kWh/week could be saved if all facilities participated.

Visual documentation of airflow patterns in a commercial fruit storage room has shown that improved air distribution is achieved when bins are tight stacked rather than spaced as is common in the industry. Improved uniformity of air distribution within the storage space is also achieved when spaces typically left to accommodate forklift operation are eliminated. Improved uniformity of air distribution within fruit storage rooms reduces time required to remove field heat, maintains more uniform fruit temperatures throughout the room and improves air cooling efficiency of the evaporator coil. All of these improvements help reduce energy use of the refrigeration system.

Continuous measurement of fruit mass loss during the three energy conservation management options indicated that fruit quality was not adversely affected. Additional studies are needed to verify this are needed.

(4) Integrated Research

Commercial scale research activities have been conducted in a room at Duckwall-Pooley Fruit Company, Odell, OR. Scale model and computational fluid dynamic simulation of airflow in a storeroom have been conducted by Mr. Supriyadi Sadi, Graduate Student in Bioresource Engineering.

Crop and Soil Science

(1) Research Overview

The overall objective of this research effort is to identify new potato cultivars for Oregon and Pacific Northwest growers. These cultivars are intended to replace existing cultivars by offering processors materials with traditional characteristics but with improved agronomic performance. Niche cultivars that offer growers and processors new market potentials are also being developed.

(2) & (3) Research Impacts and Outcomes

Several new cultivars were proposed for release in 2000 with non-exclusive licensing being investigated for the first time. Over 70,000 new clones were produced and started through the initial phases of testing. The foundation potato microtuber program continues to grow and provide growers across the region and nation with disease-free planting stocks.

(4) Integrated Research

The potato development program at OSU part of a long-term, highly effective Pacific Northwest effort involving all three PNW land grant universities as well as USDA researchers at several locations. The program is truly a cooperative effort with individual programs taking the lead on various aspects of potato development – development of true seed, microtuber production, disease assessment, quality assessments, etc.

Home Economics

(1) Research Overview

Life cycle analysis of naturally colored cotton fiber. Evaluation of color consistency throughout stages of their life time.

Research Overview – This AES research entails the study of naturally colored cotton that has been used increasingly in the past decade as commercial textile fibers due to its natural pigmentation. This pigmentation eliminates the bleaching, dyeing, and finishing normally required in the production process. Naturally colored cotton has several other environmentally friendly characteristics as well. We employed established analytical techniques to study the physical and chemical properties of naturally colored cotton fibers and the chemistry of the natural pigmentations in order to provide the baseline information for the understanding of the fibers.

(2) & (3) Research Impacts and Outcomes

As little is known about the chemical and physical structures of naturally colored cotton, the results of this research will help us to understand the performance characteristics of the fibers, to address problematic aspects of the fibers, and to provide chemical assays and measures useful in the selective breeding of colored cotton strains in order to provide consumers better colored cotton products. The improved naturally colored cottons can be made into better quality products not only for people with environmental concerns but also people with allergic reactions to chemicals and synthetic dyes, and for textiles to be used in hospitals and institutions. In addition, the improvement of naturally colored cottons provides good opportunity for an emerging cotton industry in the US and opens the global market thus allowing this US agricultural commodity to be more competitive internationally. Because of the basic nature of this work, no significant changes have yet occurred in agricultural or fiber processing processes.

(4) Integrated Research

I have either worked or consulted with faculty from various OSU departments on campus such as Chemistry, Forest Product, Soil Science, Environmental & Molecular Toxicology, and Food Science and Technology on this research.

Biology and Management of Plant Growth:

Crop and Soil Science

(1) Research Overview

Trinexpac-ethyl (TE), an inhibitor of the 3 -hydroxylation of GA20 to GA1 was investigated in field and controlled environment trials. TE effects on plant development, flowering, and seed yield in perennial ryegrass and creeping red fescue were measured. Stand age and stand density effects on root system development, flowering, and seed yield of grass seed crops were determined in field trials with bunch-type and creeping type species. The effect of stubble removal and field burning on root and rhizome development were contrasted in field trials with cultivars of fine fescue that differ in innate capacity for rhizome production.

(2) Research Impacts

Seed producers benefited from increased knowledge of grass seed crop root systems (nothing was known previously), an understanding of stand age effects on seed yield, and the development of recommendations for best stand densities in five species of grass seed crops. Results assisted grass seed producers in the use of TE in commercial perennial ryegrass seed crops.

(3) Research Outcomes

Research results have been instrumental in dramatic reductions in field burning acreage of grass seed crops in Oregon while the number of acres grown has nearly doubled. This was once a major environmental issue. Results have also been used in field burning program management in Washington.

(4) Integrated Research

This is part of a Pacific Northwest cooperative research effort and includes researchers at least three branch experiment stations in Oregon.

(1) Research Overview

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(4) Integrated Research

This is part of a Pacific Northwest cooperative research effort and includes researchers at least three branch experiment stations in Oregon.

(1) Research Overview

This program continues to focus on large-scale (national and international level), multi-institution forage research. The major objective is to develop tools that can be used locally as well as around the world to select optimum forage species for a given environment. Such tools provide for profitable and environmentally friendly production systems and allow marketing systems to successfully develop on a global scale.

(2) & (3) Research Impacts and Outcomes

Much of the information gained through research activities is shared through the Forage Information System (<http://forages.orst.edu>). This web site is recognized as one of the best in the nation for holistic presentation of a subject area. Initial successes in developing variety selection tools by establishing agroecological zones has led to numerous federal grants for further development of concepts and zone maps using GIS-based mapping techniques. A market access research and development program in China, being done in cooperation with the Oregon Seed Council, is a direct outcome of the product zone work. Huge market opportunities may develop as a result of these efforts.

(4) Integrated Research

The Forage Information System is a cooperative program with forage researchers from across the US. The agroecozone research involves scientist from several OSU departments as well as several US federal agencies and scientists from China and other countries.

Seed Production Management

(1) Research Overview

The overall objective is to develop economically viable and environmentally sound management strategies for production of grass seed crops in the Willamette Valley. The primary focus is on annual ryegrass, perennial ryegrass, tall fescue, and fine fescue. For annual ryegrass, improving stand establishment under non-thermal residue management practices, while using cost-conserving methods of establishment, has been identified as one of the most effective strategies to improve profitability of the crop without compromising the environment. For perennial grasses, improving N fertilization practices and controlling crop lodging are still the most promising management tools for improving their productivity.

(2) Research Impacts

Those most likely to appreciate direct benefit from this research are the 1,300+ seed growers and seed production firms doing business in Oregon. Seed production is major agricultural enterprise in Oregon. In 2000, almost 567,000 acres of forage and turf grass, and legume seed were harvested with a farm gate value of over \$343 million. Grass seed crops are dominant in both acres (over 524,000) and dollars (over \$325 million.). Two-thirds of all U.S. cool-season grass seed production is grown in Oregon. Nearly all U.S. perennial ryegrass seed is produced in western Oregon. Overall 75 to 80% of Oregon seed is sold domestically with the remaining 20 to 25% going into foreign markets, which include the European Community, Japan, Canada, Korea and Australia.

(3) Research Outcomes

The most noticeable outcome of this research activity is witnessed by the rapid decline in acres of grass seed crops annually open burned. For years, Willamette Valley grass seed growers burned their fields after harvest to control diseases, weeds and stimulate new growth. Public debate over field burning essentially ended when the 1991 Oregon Legislature established a gradual phase down in the amount of acres allowed for open field burning with a final limit established at 65,000 acres. Through on-farm

demonstration projects and other educational efforts, growers learned about alternatives to field burning that contributed to a significant reduction in acreage burned while maintaining yield, seed quality, and profitability.

Willamette Valley grass seed growers, in particular, have made significant adjustments in post-harvest residue management since the phase down began. These changes have paralleled research results completed over the last eight years through grants provided by the Oregon Department of Agriculture's Alternatives to Open Field Burning program. Extensive trials in this period demonstrated that non-thermal management of grass seed production is an acceptable replacement for open field burning for the major grass species grown in the Willamette Valley in terms of seed yield and stand life. In addition, research has shown open field burning is still an important management tool, particularly for those species of grass that cannot be profitably produced without thermal sanitation.

Since 1988, Willamette Valley grass seed growers reduced the number of acres burned by more than 70 percent. At the same time, grass seed crops increased from 332,610 acres in 1988 to 479,800 acres in 2000. This reduction in field burning has occurred without a loss in seed yield or quality, and sales climbed from \$190 million in 1988 to more than \$325 million in 2000. In addition, baling of seed crop residue has created a grass straw export market. In 1999, straw balers and handlers exported approximately 500,000 tons and sold another 50 tons in domestic markets. This new commodity is valued at over \$23 million.

(4) Integrated Research

International linkages are maintained through involvement with the International Herbage Seed Production Research Group. In addition, research activities are actively discussed in collaboration with peer researchers in Washington and Idaho. The USDA-CSREES Special Grant, Grass Seed Cropping Systems for a Sustainable Agriculture, has been very instrumental in facilitating regional cooperation. Locally, cooperation with research scientists at the USDA-ARS National Forage Seed Production Research Center contributes to the breadth of our interface with the Oregon seed industry. Finally, communications are frequently with several university and AES branch station scientists in planning our research program.

Horticulture

I. Flowering, growth, development and yield of hazelnut

(1) & (2) & (3) Research Overview, Impacts and Outcomes

Overview: Determine the physiological and molecular basis for sporophytic self-incompatibility in hazelnut

Outcome: two reviewed manuscripts

Impact: Identified molecular markers and developed molecular techniques specific to hazelnut tissues

Overview: Determine if canopy management strategies, pollinizer placement and time of shading affect flower bud development and nut set, yield, and quality of hazelnut

Outcome: increased awareness of the importance of canopy management and an increase in the practice

Impact: increase in yields, more consistent production

Overview: Evaluate cultivars and advanced selections from OSU's breeding program for precocity, consistent annual production, defects, kernel percentage and overall performance

Outcome: released Lewis and Clark cultivars

Impact: increase in yields in contrast to standard plantings, more eastern filbert blight tolerance, and better quality nuts.

Overview: Evaluate and identify potential hazelnut rootstocks

Outcome and Impact: rootstocks that facilitate the rapid introduction of newer cultivars, are stress tolerant, may serve as pollinizers

(4) Integrated Research

Collaborator: Shawn Mehlenbacher, OSU-HORT

II. Orchard floor management practices for improving soil quality and optimizing nitrogen uptake efficiency

(1) & (2) & (3) Research Overview, Impacts and Outcomes

Overview: Evaluate the effect of orchard floor management systems (OFMS) on soil quality with emphasis on soil biological characteristics
Determine if the OFMS alters nitrogen uptake efficiency, and its distribution and recycling within the tree
Determine feasibility of OFMS in commercial orchards
Cost and return analysis

Outcome: identify tree row management systems that enhance appropriate biological activity, optimize N uptake and reduce N losses from the orchard system.

Impact: optimize production and reduce the impact of excess N in the environment

(4) Integrated Research

Collaborators: David Granatstein, WSU and Tom Forge, Agriculture and Food Canada

III. Cherry cultivars, rootstocks and production systems

(1) & (2) & (3) Research Overview, Impacts and Outcomes

Overview: Evaluate sweet cherry cultivars for brine and fresh market potential in the Willamette Valley
Screen genotypes for bacterial canker tolerance
Evaluate cherry rootstocks
Evaluate horticultural techniques that may influence precocity, production, fruit size and quality, and disease susceptibility

Outcome: Identify cultivars and rootstocks that will revitalize a collapsing cherry industry. Shift commercial orchardists to fresh sweet cherry production from processing.

Impact: : Maintain or improve the profitability of family orchards in the Willamette Valley

(4) Integrated Research

Collaborators: Bob Anderson- Cornell, Geneva; Frank Kappel- Agriculture and Food Canada, Summerland; Roberto Nunez-Elisea- OSU, MCAREC.

IV. Nitrogen partitioning in cherry

(1) & (2) & (3) Research Overview, Impacts and Outcomes

Overview: Determine the effect of timing of N fertilizer application on uptake and partitioning of N in cherry trees

Outcome: Develop and optimize N management strategies that maintain or enhance productivity while minimizing the environmental impacts.

Impact: Improve the N management system to reduce excesses of N in the environment.

(4) Integrated Research

Collaborators: Tim Righetti- OSU, Corvallis; Lynn Long- OSU, Wasco County

(1) Research Overview

The overall objective is to characterize aspects of growth and regulation of fruit development in horticultural crops, especially with regard to factors influencing product quality.

(2) Research Impacts

This project is due to be terminated. Results are being written up for publication.

(3) Research Outcomes

No evidence that significant changes have occurred. The research outcomes have mostly been publications.

(4) Integrated Research

Cooperated with scientists in Food Science and Technology

Optimizing Wine Grape Production and Fruit Quality in Oregon

(1) & (2) & (3) & (4) Research Overview, Impacts, Outcomes and Integrated Research

We are manipulating soil moisture and nitrogen availability in the vineyard to improve fermentation behavior and wine quality. The aim of this interdisciplinary work involving collaborators at the department of Food Science and Technology (Barney Watson and Mina McDaniel) is to evaluate different strategies to increase nitrogen concentration in the fruit at harvest, to avoid stuck or sluggish fermentations. Both irrigation and soil cultivation had a significant impact on vine physiology and fruit composition. Nitrogen fertilization had little or no effect. This study has had a great impact on the Oregon winegrape industry that is now looking more seriously at supplemental irrigation to improve fruit composition and wine quality.

New clones of Pinot noir and Chardonnay are being evaluated. Clones most appropriate for Western Oregon growing conditions have been identified. Most of the new plantings of these two varieties use the new selections, characterized by earlier ripening.

Since the recent advent of phylloxera in Oregon, rootstock evaluation has been one of our main priorities. We have been evaluating Pinot noir performance when grafted to six different rootstocks. Considerable differences in plant size and fruit yield have been observed, while fruit composition has been little affected by rootstock.

We are currently screening 25 rootstocks available in Canada and US for tolerance to acidic soils, which prevail in Western Oregon. We have identified a number of rootstocks that are able to produce appropriate growth under low soil pH conditions.

We are evaluating interactions between scion and rootstock in a factorial experiment involving 4 varieties and 20 rootstocks. We found that rootstock response depended on the scion for certain parameters such as fruit composition. Our long-term goal is to identify the most efficient scion-rootstock combinations able to avoid drought stress, and optimize carbohydrate production and storage

We are investigating the effect of crop level on fruit composition and wine quality of pinot noir grapes, in collaboration with the Food Science Department (Barney Watson and Mina McDaniel). Crop thinning is a common practice in Oregon vineyards, often required by the buying wineries. Removal of a substantial amount of fruit decreases grape growers' revenues to a non-sustainable level. In three years of evaluation, we saw little or no effect of crop reduction on fruit composition. Results of this study

demonstrate that high quality fruit can be achieved at crop levels a lot higher than winemakers tend to limit it.

In collaboration with John Selker at the Dept of Bio Resource Engineering, Barney Watson and Mina McDaniel at the Department of Food Science and Technology, we are investigating the impact of deficit irrigation on vine physiology, fruit composition and wine quality. In addition, different soil moisture monitoring techniques are being compared to allow grape growers to select the most appropriate methods for their vineyards.

An Integrated Production (IP) Certification Program for Viticulture was created in Oregon in cooperation with grape growers and winemakers. The LIVE program (Low Input Viticulture and Enology) has been in operation four years and has recently been endorsed by the International Organization for Biological Control and Promotion of Integrated Systems (IOBC). LIVE is the first IP organization outside Europe certified by the international endorsing organization.

(1) & (2) & (3) Research Overview, Impacts and Outcomes

1. Increasing nitrogen use efficiency in deciduous plants by applying N in the fall after terminal bud set and before defoliation. This is accomplished by foliar application of urea, which mobilizes quickly into bark and root tissues. In most plants the nitrogen reserves is used for the growth of vegetative and reproductive tissues. We have disproved the old dogma that carbohydrate reserves are more important than N reserves...in fact it's just the opposite.

2. In nursery trees we have found that combining foliar fall N application with the defoliant copper chelate we can now remove leaves safely without harm to the tissues and improve the quality of deciduous nursery stock. Understanding how deciduous nursery plants benefit by defoliation has been a major break through for nurserymen. Now nurserymen from temperate areas like Oregon can defoliate trees before foul rainy weather and still maintain the quality of deciduous nursery stock. Nurserymen we work with from Washington, Oregon and California tell us that this is the single most important discovery for the bare-root deciduous plant nurseries...they also say "it's money in the bank" for them as they can remove leaves early when conditions are good and harvest trees faster, safer, at less cost, and with reduced diseases....etc. This practice is now being used in many other states in the midwest, and even Canada.

3. Uptake of nitrogen from the soil in some plants, eg. apples and pears, are dependent on soil temperature and growth status. The first noticeable N uptake occurs in apple nursery stock after spring budbreak. In contrast we have found that in almonds uptake occurs much earlier.

4. We have also found that we can saturate deciduous trees with nitrogen by fall foliar application regardless of their background N. Knowing this is very important in improving plant quality and performance. It is also very important for reducing N contamination of our ground water. We have found that insertion of the APX gene in tomato plants the plants are more resistant to environmental stresses...e.g. low temperature, UV radiation, etc. We have also inserted this in apples and we predict that this will have a major impact on reducing sunburn, which is the leading problem in apple production in the Northwest, and scald of apple fruits in cold storage. In addition these antioxidants should be a nutraceutical and be important for human health. This work is exciting and has great potential.

(4) Integrated Research

Cooperation is with scientists at Cornell University and The USDA Research Laboratory in Kearneysville, WV.

(1) Research Overview

Integrated systems for greenhouse and nursery crop production with efficient resource use and minimal environmental impact. Since 1989, we have focused on CIPS, the Closed, Insulated Pallet System for production of root-contained greenhouse and nursery plants (<http://osu.orst.edu/dept/hort/cips/>). CIPS is an alternative to the traditional nursery open container system.

Completed objectives of the CIPS program are: 1) Developed and tested embodiments of the protected diffusion zone such as the closed, insulated pallet system (CIPS) and Conserver; 2) Evaluated halophyte companion plants and production systems to ameliorate effects of saline irrigation water; 3) Quantify differences in efficacy of beneficial and biocontrol organisms in CIPS compared with the open container system. CIPS objectives yet to be researched are: 1) Delineate effects of various combinations of root and shoot temperatures (DIFRS) and thermoperiods (DIF) on plant growth and energy efficiency; 2) Quantify plant-governed hydraulic lift of water, outflow of water, fertilizer solubilization and uptake in a dual root pouch system.

There have been 2 patents (one active license agreement), 5 refereed publications, 2 PhD dissertations (Albaho and Kelley), 1 M.S. thesis (Blackburn), 2 undergraduate research thesis, 41 nonrefereed articles and 53 seminar presentations related to the CIPS program.

(2) Research Impacts

The greenhouse and nursery plant growers could have obtained benefits by using CIPS. In CIPS, plants use 90% less water and over 90% less fertilizer than that applied in the open container system (OCS) with overhead fertigation. There is also a reduction in pest management and labor with CIPS compared with OCS. Plant growth in CIPS has been equal or up to 15 times greater in CIPS compared with OCS; economic analysis show profits from CIPS to be equal or up to 8 times greater than with OCS.

(3) Research Outcomes

The CIPS patents have been licensed to a commercial company, but widespread application and use have not occurred.

(4) Integrated Research

This has been a multidisciplinary, multi-agency, multi-state team program with members in plant pathology, plant physiology, plant entomology, agricultural economics, agricultural engineering, and soils and with cooperators in private bus

(1) & (2) & (3) & (4) Research Overview, Impacts, Outcomes and Integrated Research

1. Propagation of Clonal Rootstocks. Clonal rootstocks selected for various characteristics have been of enormous benefit to apple production. Whereas there is a large collection of clonal rootstocks for apple, identifying dwarfing, precocious rootstocks for other crops has been less successful. The pear and cherry industries, in particular, are attempting to develop such rootstocks. A number of clones in each genus have been selected, but various problems in propagation have been encountered.

Compared to seedling propagation, asexual propagation of many woody species is plagued by a variety of difficulties that reduce yields and increase costs. Stem cuttings, layering and micropropagation are the methods considered for propagation of clonal rootstocks and each has a set of trade-offs affecting its use. Species characteristics, genotype, maturity and factors such as timing, treatment, propagation environment and post-propagation handling may significantly affect propagation and plant quality. These factors must be dealt with empirically to yield incremental improvements in propagation of clonal rootstocks.

2. Plant Growth Factors. We have isolated a group of compounds from pea weevil which stimulate cell division on pea pods. These compounds have been given the generic name bruchins. Bruchins were isolated from insects, but, using the same bioassay, we now have evidence that bruchins or a related group of compounds occur in plants. Any group of compounds that affect cell division as powerfully as bruchins is of great interest.

Besides stimulating cell division, bruchins also stimulate a more general plant defense response and thus can be classed as elicitors. Elicitors are of great interest for their potential in stimulating plant defense either as an alternative or an aid to pesticides.

The pea gene that controls bruchin-sensitivity also conditions another cell division response related to the UV light environment. We can now begin to make sense of this relationship and develop an understanding of how plant defense systems interact.

As part of their activity, bruchins stimulate a form of programmed cell death (PCD). PCD is a common component of plant resistance mechanisms. However, the response of pea to bruchins has characteristics that make it particularly suited for studying gene expression controlling PCD.

(1) Research Overview

This research is designed to use a variety of yield and crop performance monitoring systems to provide mapping and management tools for specific production areas. Inputs of nutrients and water will be maximized in the models developed.

(2) & (3) Research Impacts and Outcomes

Due to this effort, many growers (across commodities) are using yield mapping tools for management decisions.

Production system research and physiology of berry crops

(1) Research Overview

Research the growth, development, and physiology of berry crops and alternative production systems to increase consistency of production, maintain or improve fruit quality, reduce incidence of pests, and increase machine harvest efficiency.

(2) & (3) Research Impacts and Outcomes

Unlike raspberry, we've shown that trailing blackberry plants take up nitrogen throughout most of the growing season. Our research has changed fertilizer practices on over 5,000 acres of blackberry: growers are now delaying the first N application and many are reducing N rates by as much as 25%.

Our work has shown that foliar feeding of nitrogen is not effective in strawberry. This should save many strawberry growers as much as \$400/acre (= \$1 million/year).

High-density plantings in blueberry have produced 104% greater yield over 7 years of production compared to the traditional 4' in-row spacing. Over 250 acres/year, for the last 3 years, have been planted at 30-36" in Oregon (and a similar acreage/year in Washington) as a result of our findings.

Growers are trellising machine-harvested blueberries after our research showed that trellised fields had 3 to 8% greater recovery of total yield (as much as 1,000 more pounds/acre = \$700). The cost of the \$500/acre trellis is thus paid for in one year.

We have been evaluating cultural/production methods to reduce thorn contamination in machine harvested 'Marion' blackberry. Our preliminary work has shown that a winter "clean-up" with a machine harvester equipped with rotary heads and brushes can reduce thorn contamination of the machine-harvested 'Marion' fruit the following season by 74%. This technique is being further tested this winter. Impact could be more machine-harvested fields (a cost savings of \$0.11/lb. to the grower) and a processing premium advantage of \$0.05/lb (potential impact of \$750,000/year).

A "no prune" system developed in 'Marion' blackberry has produced higher yields as plants are more tolerant to cold stress, reduced pesticide requirements, but must be hand harvested due to potential increased thorn contamination in machine-harvested no-prune systems.

Our work has shown that the hardy kiwifruit initiates flower buds the year prior to fruiting and that initiation is reduced by shade. Thus canopy management in the current season is important to maximize yield the following year.

(4) Integrated Research

USDA/ARS scientists, Corvallis; County Extension Faculty, OSU

Klamath Experiment Station

Small Grain Management

(1) Research Overview

Our goals are: 1) to develop annual legume-small grain intercropping system to provide ground cover and suppress weeds while increasing or not affecting grain yield, 2) to develop sampling techniques to accurately assess adult wheat stem maggot (wSM) population levels in the spring and determine economically significant WSM levels and 3) to identify methods for controlling WSM in spring seeded small grains. Develop and identify wheat, barley, and oat varieties adapted to the Klamath County, Oregon.

To accomplish these goals, research will be conducted to develop sampling techniques that accurately assess WSM population levels in the spring, to identify economically significant early spring adult WSM population levels, and develop a model predicting time and duration of WSM emergence in the spring. Studies evaluating annual forage species for interseeding in spring planted barley are underway. The interaction of barley variety and variety height with different annual forage species is also being examined as are studies to determine the effects of barley and forage species seeding rate on barley grain production, fall forage production, and plow down biomass and nitrogen. Variety development and evaluation is being conducted in cooperation with breeding programs throughout the Northwest.

(2) & (3) Research Impacts and Outcomes

Intercropping Austrian pea with oats for hay increased crude protein (CP) and relative feed value (RFV) and lowered acid detergent fiber (ADF) and neutral detergent fiber (NDF).

Applications of selenium soil amendment were shown to increase concentrations of selenium in pasture forages. These increases in Se concentrations varied with plant species and intervals following applications. Annual applications appear to be necessary.

Across an array of cool-season grasses over three growing seasons, higher yields were realized from harvests for hay as compared with more frequent cutting imitating grazing conditions. A group of tall

fescues were the highest yielding type of forage grasses, being similar over three years to 'Matua' bromegrass. Initially 'Matua' was the highest yielding grass entry. However, yields for 'Matua' declined over time with stand persistence becoming a problem.

The use of goats to thin leafy spurge stands appears promising. Long term effects on this difficult to control perennial weed from goat grazing requires further research.

Chemical control of Barley Stripe Rust seems feasible with combinations of seed and foliar applied materials. Resistant varieties with good agronomic performance have been identified and are being increased.

Sustainable agronomic practices must be refined to maintain economic viability for Klamath Basin producers. Research results have shown better methods to accomplish forage and grain production. These methods include variety selections, timing of harvests, and chemical inputs.

(4) Integrated Research

Potato, Sugarbeet, and Water Improvement and Management

(1) Research Overview

Potato research activities in 2000 included full-scale participation in Oregon and Western Regional variety development programs. Cultural management research was conducted on several new varieties to determine nitrogen fertility requirements, seed conditioning response, and response to seed treatment for silver scurf control. Sugarbeet research on variety development and weed management were terminated by frost damage to initial and replanted trials. Water quality monitoring studies were continued for the third year to evaluate the potential contributions from agricultural activities on nutrient loading of surface waters.

(2) Research Impacts

The Oregon potato variety development program released two new processing varieties in 1999 and three new fresh market varieties in 2000. Umatilla Russet was grown on about 50,000 acres in the Pacific Northwest in 2000. This variety is having a major impact in the frozen French fry industry. Klamath Russet and Mazama and Winema are potentially important new fresh market varieties that may be very well suited to the Klamath Basin fresh market industry. Very limited seed supplies will delay rapid commercialization of these varieties.

Sugarbeet production ceases in the Klamath Basin after the 2000 crop as processing facilities in Northern California are being closed. Variety use in the Klamath Basin for the past several years was based on performance of varieties in official trials conducted at KES and the sister UC Davis station at Tulelake, CA. Past research at KES also provided guidelines for weed management, stand establishment, and nitrogen fertilizer requirements.

Water quality monitoring by KES has provided new data on the relative nutrient loading of surface waters by agricultural versus natural background sources. This data will be useful as TMDLs are established for two sub-watersheds in the local area.

(3) Research Outcomes

Potato variety selection for northwest production has been highly influenced by new varieties developed in Oregon and regional programs. Variety-specific cultural management guidelines have been developed for these new varieties at KES and sister stations over several years. Over 50 percent of production in Oregon and Washington are based on varieties developed over the past 15 years. This is a major reason for the rapid gains in per acre yields achieved in the past decade.

Significant yield improvements and production efficiencies in local sugarbeet crops resulted from local research. However, the closure of processing facilities in California has eliminated this crop which contributed about \$80 million in farm gate receipts to the local economy over the past 10 years.

Water quality monitoring has demonstrated less importance of agricultural contributions to nutrient loading of surface waters in the Upper Klamath Basin than was previously assumed. This information will be important in the process to assign TMDLs to water quality limited bodies in the region.

(4) Integrated Research

Potato variety development research activities are predominantly integrated with sister institutions in Oregon, Washington, Idaho, California, Colorado, North Dakota, and Texas. The USDA-ARS is also a partner in this effort. This is reflected in the recent variety release documents, which show joint releases in each case. Most of the sugarbeet research conducted over the past decade was cooperative efforts with the UC Davis Intermountain Research and Extension Center at Tulelake, CA. A portion of the water quality monitoring efforts were coordinated with and will relate to extensive monitoring being conducted by UC Davis personnel in California portions of the Klamath Basin.

North Willamette Research and Extension Center

Optimizing Vegetable Crop Management in the Willamette Valley

(1) & (2) & (3) & (4) Research Overview, Impacts, Outcomes and Integrated Research

The goal is to maintain or increase yield and quality of vegetable crops while reducing inputs for fertilizers, labor, and pesticides, and reducing negative environmental impacts. The major focus in the last three years has been on reducing applications of nitrogen fertilizers to vegetable crops and on developing new crops for the area.

In the year 2000, six varieties of sweet corn were grown with two different rates of N fertilizer. We find that there are large differences among varieties in efficiency of N utilization with some varieties producing optimal yields with no more than half the applied N required by the industry standard variety 'Jubilee.' These varieties are characterized by dark green leaves that maintain their color at low rates of N and as the crop matures. Residual soil nitrate after harvest of these varieties is not, however, lower than for 'Jubilee.' The pre-sidedress soil nitrate test was tested in seven grower fields. Implication of this test has resulted in a 25 percent average reduction in the amount of N being applied to sweet corn.

Sweet corn was also grown at three rates of N and following four different winter cover crops or a winter fallow. Winter cover crops contributed very little to the nutrition of the sweet corn crop but did result in a 45 percent reduction in the amount of nitrate leached after the bean crop that was on the same plots in 1999.

Edamame (vegetable soybean) was grown at four rates of nitrogen fertilizer and with and without inoculation. Largest yields were obtained at only 40 lb. applied N/acre, regardless of presence or absence of inoculum. Inoculated plants were darker green and produced more foliage but did not produce higher pod yields. The research on edamame involves cooperation with Dr. Carol Miles of Washington State University. Her experiments are usually variety trials, while the OSU research focuses on cultural methods.

(1) & (2) & (3) & (4) Research Overview, Impacts, Outcomes and Integrated Research

Completed studies of container production of nursery crops in retractable-roof structures compared to "traditional" production systems. Selected taxa grew larger using reduced irrigation when over-wintered, and summer-shaded, in retractable roof shading structures compared to stationary shading structures. Disease infestations were less frequent when produced in the retractable roof compared to the stationary roof structure. Flowering and new growth of selected crops was regulated using retractable roof structures, and a technique called "cold-trapping" was replicated. This procedure allows Oregon growers to ship plants "in-flower" for sales in regions of the country with a later growing season. Replicated studies of shade tree production using containers with raised drain holes. Raised drain holes did not significantly influence shoot growth, but root growth was influenced. Maple species vary in their ability to grow roots in the water-saturation zone of containers with raised drain holes. Continuing studies of adult root weevil control in container production systems indicated that control procedures must be modified based on the species of root weevil infesting the containers.

Mid-Columbia Agricultural Research and Extension Center

Stone Fruit Horticulture

(1) Research Overview

The sweet cherry industry of the Pacific Northwest is undergoing a radical transformation due in great part to the recent availability of dwarfing rootstocks and of early and late season cultivars that produce large, high-quality fruit. The industry emphasis is to increase production of high-quality cherries for the fresh market. Development of small trees that facilitate harvesting is important. Research efforts are focused on developing orchard production systems based on compact, precocious trees that will begin producing commercial, high-quality crops in the 3rd or 4th year.

The main goals include: (1) evaluation of training and pruning methods; (2) evaluation of cultivars and rootstocks; (3) studies of reproductive biology (pollination of Regina and flower and fruit thinning to increase fruit size in Lapins); (4) evaluation of deficit irrigation to increase precocity and control tree size of Lapins on Mazzard rootstock; (5) evaluation of sweet cherry ('Regina' on 'Gisela 6' rootstock) in an Integrated Fruit Production research plot, with emphasis on improved water management and economic analysis of production costs.

(2) Research Impacts

Most of the research is still in progress. Research results will mainly benefit growers of The Dalles and Hood River sweet cherry growing districts. Work on flower and fruit thinning is expected to produce practical results within 3 years.

Results of irrigation management are expected to have an impact within 3-5 years. A more efficient use of irrigation water is expected to result in considerable water and fertilizer savings, and a reduced risk of nutrient leaching and run-off.

(3) Research Outcomes

Initial results have shown that the central leader training system helps to advance precocity and growers are adopting it. There is interest in new cultivars that produce very early (The Dalles) or very late (Hood River), to avoid the current production surplus of the first week of July, that results in reduced crop value.

(4) Integrated Research

Research is being conducted in cooperation with other researchers of the Horticulture Department-OSU, OSU-MCAREC in Hood River, OSU Extension Wasco County, and Washington State University, University of Florida, and Washington Tree Fruit Research Commission.

(1) Research Overview

Evaluation of rootstocks for pear and apple production. Evaluation of both rootstocks and cultivars as interstems for pear production. Selection and evaluation a new series of pear rootstocks developed in Oregon. Evaluate tree budding height as it relates to tree size and productivity. Evaluation of crop and water stress as it relates to Columbia Red d'Anjou survival. Coordinator of NC-140 pear rootstock trials.

(2) Research Impacts

Increased knowledge of rootstock and cultivar performance enables growers to make wiser choices when replanting existing orchards. Rootstock or interstems selections enable a grower to produce crops of larger sized pears, which the markets are demanding.

(3) Research Outcomes

Two of the initial Horner pear rootstock selections being developed offer, reduced tree size, increased productivity, and enhanced fruit size. The major advantage the Old Home by Farmingdale rootstocks has in increasing production and grower returns is between years 3 and 7. As the trees reach 10 years of age, few significant differences in annual production exist. Betulaefolia seedling rootstocks, while not tree size controlling, consistently produced the largest sized Bartlett pears. The South African rootstock BP-1 when used as an interstem significantly increases fruit size of d'Anjou or Bartlett pears. The Conference cultivar, when used as interstems, consistently produces smaller Bartlett, Bosc, and Comice trees. Yield efficiency of Comice is dramatically increased with the use of Bosc interstems. Budding trees at 9 inches as compared to the normal 3 inches increased productivity and fruit size. Both crop and water stress reduce Columbia Red d'Anjou root carbohydrates, and appear to increase the severity of red d'Anjou failure.

(4) Integrated Research

Cooperate with other scientists OSU (MCAREC, SOREC, and Horticulture), the western states (Washington, California, Idaho, Colorado, Utah), and the US (Arkansas, Georgia, Iowa, Illinois, Indiana, Kansas, Kentucky, Massachusetts, Michigan, Minnesota, Missouri, Nebraska, New Jersey, New York, North Carolina, Ohio, Pennsylvania, South Carolina, South Dakota, Tennessee, Virginia, Vermont, Wisconsin).

Central Oregon Agricultural Research Center

Forage Management and Improvement in Central Oregon

(1) Research Overview

Acres of hay and pasture in central Oregon represent the largest agricultural crop. Present on-station research includes two alfalfa variety trials at Madras and Powell Butte (1998-2002), two alfalfa seeding rate trials at Madras and Powell Butte (1998-2002), two alfalfa fall dormancy (FD's 1-6) trials at Madras and Powell Butte (1998-2002), one Potassium and Sulfur Fertilizer Rate Effect on Alfalfa Production Trial at Powell Butte (1998-2003). On-station research since 1996 has included long term weed control effects on alfalfa production at Powell Butte (1990-1996), irrigated agro/ecozone adaptation of grass species for

hay production at Powell Butte (1994-1999), dryland agro/ecozone grass, legume and forbe adaptation demonstration at Powell Butte and Madras (1994-2001), alfalfa variety trial at Powell Butte (1995-1999), alfalfa fall dormancy effect on yield and quality at Powell Butte (1995-1999), and Corn Silage trials at Madras (1999-2000). Past on-farm research includes: t-sum nitrogen fertilization effect on grass pastures - two sites at Madras and Powell Butte (1999-2000), t-sum nitrogen fertilization effect on grass hay fields - two sites at Madras and Powell Butte (1999-2000) timing, rate and source of nitrogen fertilizer effect on meadow hay – two sites: Seneca (1999-2000) and Paisley (1998-2000), and effect of Malathion, elemental sulfur, and liquid sulfur on clover mites in orchardgrass at Tumalo (2000), and Corn Silage Trials at Madras (1999-2000).

(2) Research Impacts

Research is conducted on grass and alfalfa to evaluate the yield potential of the different species and varieties. The alfalfa varieties have varying degrees of resistance to different pests, disease, and nematodes. Central Oregon has several pests that cause reduced yields. The different species of grasses have different yield potentials and adaptation. The variety trials are one tool to help screen the best varieties and species to be grown by the producers of central Oregon. Producers can make a more informed decision on what species of grass, or variety of alfalfa to plant, and how to best utilize the results for their individual operation.

(3) Research Outcomes

On alfalfa, there are 0.75 – 1.0 ton/acre differences between the top yielding and lowest yielding variety. In present market conditions, that represents about \$75-100+/acre difference to the producer. On grass hay species, there has been a two- fold difference in yield between the top yielding and lowest yielding grass hay species. Producers know which species will work best for their varied soil and climatic conditions of central Oregon. The yield difference is also two fold in potential gross income.

(4) Integrated Research

Forage research has not been highly integrated with other crop research, but is held each year at Pacific Northwest Forage Workers Conference and Annual OSU Forage and Pasture Working Group Meeting. There is however many cooperators. Cooperators include: David Hannaway, Extension Forage Specialist, John Hart, Extension Soil Specialist, Neil Christensen, Extension Soil Specialist, Don Clark, Forage Research Agronomist, County Agents: Tim Deboodt (Crook Co.), Gary Delaney (Grant Co.), Marni Porath (Lake Co.), Shelby Filley, (Douglas Co.), Troy Downing (Tillamook Co.), Gene Pirelli, (Polk Co.), Jay Car, (Baker Co.), Wayne Mosher, Extension Emeritus, Glenn Fisher, Extension Entomologist, and Peter Sexton, COARC. Plant Physiologist. Funding comes from various Alfalfa Seed Companies, Oregon Dept. of Agriculture, Jack South worth, Rancher, and OSU Ag Experiment Station.

Columbia Basin Agricultural Research Center

Sustainable Soil, Water and Crop Management Strategies for Semiarid Oregon

(1) Research Overview

The mission of this research program is to develop soil, water and crop management practices that sustain the soil and water resources of semiarid Oregon and improve the economic standing of dryland agriculture. Specific objectives are to investigate: 1) practical and economical tillage, residue management, and direct seeding practices that protect the soil and water resources of semiarid Oregon; 2) nitrogen management practices that optimize crop yield and quality, and minimize environmental risk; and 3) economically promising alternate crops that are resource conserving, require fewer purchased inputs, or preserve soil quality.

(2) Research Impacts

This research benefits dryland growers in eastern Oregon and southeast Washington by providing better and more economical methods of managing cropping systems through soil and water management. In addition, citizens of the region benefit by improvements in management of soil and water resources.

(3) Research Outcomes

Acres in direct seed and annual cropping systems has increased from less than one percent to about ten percent over the past five years. Currently, about 100,000 acres annually are sown by these methods. Winter Canola was sown on approximately 20,000 acres in the fall of 2000. Information generated from this research has been used in direct seed cropping systems and by growers sowing winter Canola. The resource benefits provided by these systems are the indirect result of research trials conducted.

(4) Integrated Research

This research cooperates with researchers, extension agents and agency personnel from university and county, state, federal and tribal agencies. These include:

- Oregon State University
 - Columbia Basin Agricultural Research Center
 - Department of Crop and Soil Science
 - Extension Service
- University of Idaho
 - Department of Plant, Soil and Entomological Sciences
- Washington State University
 - Department of Crop and Soil Sciences
- State of Oregon
 - Department of Agriculture, Natural Resources Division
 - Department of Environmental Quality
- U.S. Department of Agriculture
 - Agricultural Research Service
 - Natural Resources Conservation Service
 - Farm Service Agency
 - Risk Management Agency
- U.S. Environmental Protection Agency
- Confederated Tribes of the Umatilla Indian Reservation

Biology and Management of Animal Production:

Animal Sciences

Active research programs identified above enhance a better understanding of the biology of the animal production system. This enhanced understanding will lead to improved efficiency and sustainability of animal production systems.

(1) Research Overview

My research program primarily is targeted towards investigation of beef production systems and the impacts of management decisions/alternatives on productivity, profitability, and sustainability of beef production practices. Overall, we expect this research to aid producers in making decisions related to profitability and sustainability of their production systems. We will use this information to aid in

development of extension programs that encourage the use of management alternatives which enhance both the profitability and sustainability of beef production.

(2) Research Impacts

(3) Research Outcomes

This is the first year of my research program, most are nowhere near completion, and some have not been started yet. Therefore, it is impossible to evaluate any possible impacts from research in the past year.

(4) Integrated Research

I am currently cooperating with Dr. William Kruger, Department of Rangeland Resources, on a program regarding riparian area management at the Animal Science Department's Soap Creek Ranch. I am also cooperating with Dr. David Bohnert, Eastern Oregon Agricultural Research Center, on research evaluating the impacts of feeding endophyte infected Ryegrass straw of beef cattle health and productivity.

Function of various proteolytic systems in muscle protein degradation

(1) Research Overview

Goals of the research were to identify: 1) functions of calpain and the multicatalytic protease (proteasome) on L8 myotubular protein degradation, 2) effects of specific inhibitors of proteases on stabilities of individual myofibrillar proteins, and 3) roles of m-calpain, specifically, in muscle protein degradation. Secondary goals were to assess roles of calpains and the proteasome in the degradation caused in L8 myotubes by serum-withdrawal and by dexamethasone (a synthetic glucocorticoid). In summary, we have completed most of this work as outlined. We discovered that both calpain and proteasome are involved in protein degradation in L8 myotubes, that calpains are responsible for initiating the bulk of degradation, that m-calpain is responsible for roughly 30% of degradation and that calpains specifically degrade nebulin, fodrin and desmin. We determined that the stimulation of degradation caused by serum-withdrawal from cultured cells, a model of accelerated degradation, involves m-calpain activity.

(2) Research Impacts

The people who benefit from this work include basic agricultural scientists who are struggling to identify targets for growth manipulation in farm animals. Based on our work, we have confidence that manipulation of in vivo muscle calpain activity will increase skeletal muscle protein accretion. A second group who benefits from this research are human and animal health professionals who are interested in basic cellular mechanisms which underlie muscle-wasting diseases. Our work has shown that calpains mediate a portion of muscle protein degradation and may serve as convenient targets for regulation in both livestock (to enhance muscle growth) and in humans (to minimize muscle wasting).

(3) Research Outcomes

The research performed has contributed significantly to the understanding of protein homeostasis in skeletal muscle. Our work has been cited frequently by others and has been used to advance the model of muscle protein degradation.

(4) Integrated Research

Several research collaborations have been developed and supported as a result of this work. First, our laboratory has been requested to supply a combination of antibodies and expression plasmids which we

generated in the study. Eight research laboratories across North America have requested biological materials from us. To conduct the research, we have also relied upon expertise available at OSU (EMT Department in the College of Agricultural Sciences), and Oregon Health Sciences University (Oral Molecular Biology, School of Dentistry).

(1) Research Overview

More than half of total calf weight is accrued during the last two months of gestation and calf nutrient requirements increase exponentially as gestation progresses. Feed intake of pregnant dairy cows decreases approximately 30% during the last three weeks of gestation. Unfortunately, the reduction in feed intake coincides with increasing nutrient requirements of the calf. Most health problems in dairy cattle occur in early lactation and have been associated with relatively low intake prior to parturition. Hence, prevention of feed intake decline prior to parturition should improve health and production in the subsequent lactation and therefore profitability of the dairy enterprise. The depression in feed intake prior to parturition is likely controlled by blood metabolites. This is a plausible hypothesis since blood metabolites change dramatically several weeks preceding parturition. Preliminary results show that feed intake prior to parturition declines significantly less in Jersey cattle compared to the Holstein cattle. Therefore, Jersey breed is being used as a model to determine the factors that influence feed intake of Holstein cattle, the predominant dairy breed in the US.

(2) Research Impacts

This work will have a positive influence on the environment. Increasing feed intake prior to parturition will improve health and therefore production in the subsequent lactation. The number of cows required to produce a desired amount of milk will be less.

Potential economic savings for the Oregon dairy industry could exceed \$7 million. Savings are due to prevention of depressed milk production in early lactation. Every dollar a dairy producer receives generates approximately \$2.5. Therefore, the potential economic impact to the Oregon economy could exceed \$17 million.

Positive economic consequences will enhance the lifestyle of Oregon dairy families. The additional revenue generated by the dairy production industry will benefit dairy communities and the state of Oregon.

(3) Research Outcomes

This is a new effort. Results will be presented at professional meetings, dairy related production courses, and extension workshops. Results are currently unpublished, but will be submitted to dairy related scientific journals, popular press, and extension publications.

(4) Integrated Research

This work is being done in collaboration with faculty at the University of Wisconsin and Virginia Tech.

(1) & (2) & (3) Research Overview, Impacts and Outcomes

Research programs in poultry genetics are active and ongoing. In addition, research in embryonic development and sperm mobility will lead to genetic selection that will enhance the efficiency of poultry and livestock production.

(1) Research Overview

The focus over the past many years has been to examine the hormonal relationships, concentrations and mechanisms during pregnancy in mares, cows and ewes. The approach has been to identify and quantify steroid hormones in blood, urine and feces and relate these to normal or disease conditions.

(2) Research Impacts

In mares, hormone therapy to prevent abortion is often applied, without knowledge of normal or abnormal values. This research should provide producers and veterinarians a more rational basis for timing and amount of treatment needed. In ewes, estimating fetal number (single, twins or triplets) may be possible by measuring fecal hormones with a quick, bench-top test. Producers could then more efficiently manage feeding of ewes.

(3) Research Outcomes

In pregnant mares, specific progestin steroid hormones increase rather abruptly after about 89 to 90 days gestation; the source is the fetus and placenta. Such increases signify a normally functioning fetoplacental unit. In pregnant ewes, concentrations of specific progestins in feces correlate with fetal number. However, the predominant steroid varies with stage of gestation. The predominant steroids are quite different among species (mares, cows or ewes) and source (blood, urine or feces); thus specific tests must be developed for each.

(4) Integrated Research

In past years, cooperative efforts with Auburn University and the University of Missouri explored effects of endophyte-infected fescue forage on mare reproduction. A cooperative effort at this station with the College of Veterinary Medicine is exploring progestins in llamas.

(1) Research Overview

My research focus in the last ten years has been in the understanding of fat cell development and differentiation. Since we do not know much about how new fat cells are made in animal body, it is difficult to develop new strategies to reduce body fat in meat animals. My research in the last several years were using various compounds, which are known to reduce body fat when fed to animals, in cell culture system to identify cellular events which were affected by these compounds. We have established that fat cell differentiation is strongly inhibited in cell culture by several very diverse compounds, such as dioxin (an environmental toxin), retinoic acid (a fat soluble vitamin A), and conjugated linoleic acid (a long chain fatty acid found in meat and dairy products). We identified a nuclear transcriptional factor protein, COUP-TF, which is elevated in the cells when any of these three compounds are used. Therefore, I have been trying to define the role of COUP-TF in fat cell differentiation process. The approach I adopted including establishing cell lines that are capable of synthesizing COUP-TF when we add inducing agent in the medium. I will be able to study the fat cell differentiation process in the presence of elevated and depressed COUP-TF inside the cells.

(2) Research Impacts

Since I am the first scientist to publish a paper to describe the possible link between COUP-TF and fat cell differentiation, many other scientists working in adipose tissue research have begun to examine this particular protein in their own studies.

(3) Research Outcomes

This research is basic in nature, and has no direct financial return at this time. However, I was able to attract an industry grant of \$90,000 to support my research effort.

(4) Integrated Research

Currently, I have no collaborators for this particular effort. Although I do have collaborators in general fat reduction research. These include faculty members from other universities, industry, and scientists from other countries.

Germ Cell and Embryo Development and Manipulation for the Improvement of Livestock

(1) Research Overview

Extracellular matrix-degrading proteinases include the plasminogen activator (PA) and matrix metalloproteinase (MMP) families and play pivotal roles in early embryo development and embryo association with the uterus. The specific aims of this research have been to evaluate expression of components of the PA and MMP families during the periods of embryonic expansion and elongation and uterine attachment in sheep and cattle. Embryos and uterine sections will be recovered from donor cows and ewes and either extracted for RNA or fixed for histological preparation. RT-PCR will be used for determining the phenotypic expression pattern of the genes of interest. Localization of the cells expressing the specific genes will be conducted using in situ hybridization. For experiments involving analysis of secreted proteins by cultured embryos, conditioned medium will be analyzed by immunoblotting and zymography. These experiments will provide a comprehensive analysis of the expression pattern and cellular localization of the genes of interest during the cited periods.

(2) Research Impacts

Our laboratory has been mapping the temporal expression of these families of proteases and protease inhibitors during early pregnancy in sheep and cattle. Expression of specific proteases and protease inhibitors in the embryo and uterus correlate to a particular developmental event. Information generated from this research has contributed to updating the knowledge of the biochemical mechanisms involved in embryonic growth and association with the uterus.

(3) Research Outcomes

Significant changes of an applied or industry nature have not been realized in the state or elsewhere from this work. However, this research has the potential to provide the basis for refining and redesigning selection criteria for reproductive traits in livestock.

(4) Integrated Research

This is part of Western Regional Project W-171, which is comprised of contributors from several states in the western region. However, interest in this group has grown to the point where the membership includes active participation from states outside the region, e.g. Louisiana, Arkansas, Connecticut, as well as contributors from Canada.

Increasing Sheep Productive Efficiency

(1) Research Overview

Two research programs have been initiated to evaluate the merits of sheep breeds recently imported into the U.S. The first one compared the merits of the Dorper, promoted as a sire of market lambs, with the Suffolk, the breed most commonly used for that purpose. Primary differences observed in crossbred lamb of the two breeds were slower growth and fatter carcasses for Dorper-sired lambs. The second one is examining maternal benefits from incorporating genes of the East Friesian, a European milk breed, into the Polypay, a prolific U.S. breed. Preliminary results from young ewes indicate no reduction in ewe prolificacy but little benefit in lamb growth rate. Mature ewes will be challenged to raise twin and triplet lambs to assess their lamb producing ability.

(2) Research Impacts

Since producers are paid on total weight of lamb marketed, all producers are in a position to benefit from changing their breeding programs to incorporate new genetic material beneficial to their management and marketing conditions.

(3) Research Outcomes

Our research findings have been instrumental in Oregon sheep producers avoiding use of the Dorper breed as a sire of market lambs. Meanwhile many producers are keenly awaiting the outcome of the East Friesian trial before incorporating the breed into their own production flocks.

(4) Integrated Research

Both programs are part of collaborative research being coordinated and communicated across the U.S. through NC-190 and more specifically in the western states through WCC-39. Dorpers are being evaluated under an array of management conditions at four Expt. Stations and East Friesians at five locations.

Reproductive Performance in Domestic Ruminants

(1) Research Overview

Research is being conducted to examine the mechanism of action of prostaglandin F2 in stimulating the exocytosis of oxytocin from the bovine corpus luteum. In particular, effort is being channeled to study the role of a myristoylated alanine-rich C kinase substrate (MARCKS) protein in facilitating the extrusion of oxytocin granules from large luteal cells. Research is also being conducted to determine whether the ovarian hormone progesterone acts nongenomically to alter binding of oxytocin to its receptor in ovine endometrium. Results of this research suggest that progesterone may act at the level of the plasma membrane to suppress binding of oxytocin to its receptor.

(2) & (3) Research Impacts and Outcomes

This research contributes to our understanding of how prostaglandin F2 and oxytocin are functionally interrelated in terms of their roles in regulating the utero-ovarian function. This knowledge can serve as a basis for using these hormones to further improve methods of estrous synchronization in domestic animals.

(4) Integrated Research

Research conducted on the action of prostaglandin F₂ and oxytocin receptors has involved cooperative efforts with scientists in the Department of Zoology, and the OSU Environmental Health Sciences Center, as well as Washington State University.

Eastern Oregon Agricultural Research Center (Union and Burns)

(1) Research Overview

My AES research currently involves improving utilization of low-quality forage. In addition, I collaborate extensively with the USDA scientists stationed at the Eastern Oregon Agriculture Research Center in Burns, OR.

(2) Research Impacts

Studies have focused on the effects of rumen protein degradability and supplementation frequency on ruminant performance, nutrient utilization, and grazing behavior. In addition, other research has included non-structural carbohydrate supplementation of ruminants grazing high-quality forage. Preliminary results suggest that infrequent supplementation (as infrequently as once every 6 days) of low-quality forage with protein ranging from 40 to 80% rumen degradable will yield results similar to daily supplementation for ruminant performance and overall nutrient utilization. Also, non-structural carbohydrate supplementation of ruminants consuming early season native flood meadow does not appear to provide economic or performance benefits.

(3) Research Outcomes

This research will provide beef producers with economical management alternatives that will lower feed costs without adversely affecting animal performance.

(4) Integrated Research

Animal Health and Welfare:

Animal Science

Research in the Department of Animal Sciences addresses reproductive health problems, survivability in the chick, and sudden death syndrome in broilers. Completed research has elucidated the problem of high nutrient density from animal manure (potassium) on Dairy cow reproduction.

(1) Research Overview

This program is testing the inclusion of certain types of polyunsaturated fatty acids (PUFA), especially long chain n-3 PUFA and conjugated linoleic acid (CLA) in an attempt to incorporate these health-enhancing fats into egg and poultry meat products, thereby benefiting both producers and consumers. Animal products contribute 70% of total fatty acids and 100% cholesterol in a typical western diet. Concern by health professionals over the possible health risk of a high fat diet is well documented. Increased public awareness has led to a decrease in consumption of animal products over the past 25 years, especially chicken eggs. This trend will presumably continue as dietary fatty acids and cholesterol are linked with several important diseases. Certain types of PUFA, especially long chain n-3 PUFA and

CLA have been reported to have health-enhancing properties, including (1) triglyceride lowering, antiatherosclerotic and antiarrhythmic properties of n-3 PUFA; (2) antiatherosclerotic, anti-cancer activity; and (3) immune enhancing properties of n-3 PUFA and CLA. Per capita current intake of CLA is only several hundred milligrams/day, while based on animal data, an estimated 3g/day of CLA is required to produce beneficial effects in humans. Humans do not have the ability to synthesize CLA, so it has to be supplied through diet. CLA when associated with food has been reported to have higher tissue retention and better anticancer effects than as commercially available supplements. Dietary CLA is contributed by food products of ruminant origin, such as dairy and beef. However, as Americans are opting for low fat dairy products and choosing more poultry foods than beef, it is likely that dietary contribution of CLA will further be reduced. Incorporation of such health-enhancing fatty acids into eggs and poultry meat could lead to novel product development and increased marketability of these products. The approach to altering chicken egg and meat fatty acids is to include appropriate fat sources in the diet of laying hens and broiler chicks.

(2) Research Impacts

Results from our work in 2000-2001 has shown that up to 5.4% of CLA could be incorporated to egg yolk lipids; thus, an average chicken egg could provide up to 300-320 mg of CLA to the human diet. The content of lipid oxidation products as measured by total volatile content were reduced in eggs from CLA-fed hens suggesting an antioxidant role of dietary CLA. As consumers are more interested in foods that provide added health benefits, these results may lead to increased demand of specialty foods with added product quality.

(3) Research Outcomes

The shell egg industry is built on the egg's reputation as an economic, perfectly packaged, portion controlled highly nutritious food item. However, the per capita consumption of shell eggs for domestic table egg use continues to reduce. The niche market for specialty eggs are increasing in the US. Specialty eggs are priced about 2.9 times higher than regular eggs. In 1999, the state of Oregon produced 80, 809, 000 dozen-shell eggs worth 53.2 million dollars. Considering the higher price of specialty eggs, development of value-added eggs and egg products will enhance the marketability of eggs statewide, nationally, internationally and will lead to more returns for the egg industry.

The following abstracts are submitted for presentation in the upcoming Animal Science meetings from the research conducted in 2000-2001.

1. Gita Cherian, Troy B. Holsonbake, Mary P. Goeger, and Rob Bildfell. 2001. Conjugated Linoleic Acid Alters Egg Yolk Fatty Acid Composition and Hepatic Histopathology of Laying Hens. (To be presented at the Poultry Science Annual Meeting, Indianapolis, July 2001).

Gita Cherian, Troy B. Holsonbake, Mary P. Goeger, and Dong U. Ahn. 2001. Conjugated Linoleic Acid Alters Egg Yolk Fatty Acid Composition and Volatile Compounds in Raw, Cooked and Irradiated Eggs. (To be presented at the Poultry Science Annual Meeting, Indianapolis, July 2001).

Gita Cherian, Troy B. Holsonbake, Mary P. Goeger. Lipid and Fatty Acid Composition of Specialty Eggs (To be presented at the Poultry Science Annual Meeting, Indianapolis, July 2001).

The following paper is submitted for publication in Poultry Science Journal.

Gita Cherian, Troy B. Holsonbake, Mary P. Goeger. Fatty Acid Composition and Egg Components of Specialty Eggs (submitted, April 03, 2001).

(4) Integrated Research

Dr. R. Bildfell, OSU College of Veterinary Medicine (Histopathology)

Dr. D.U. Ahn, Professor, Dept. of Animal Science, Iowa State University, Ames (Product Quality)

Environmental and Molecular Toxicology

Use of Animal Models to Study Carcinogenic Mechanisms and Chemoprotective Effects

(1) Research Overview

This research is focused into two major areas, the first aimed at exploiting the utility of two fish models, the rainbow trout (*Oncorhynchus mykiss*) and the zebrafish (*Danio rerio*), to study carcinogenic mechanisms, particularly those relating to the bioactivation of the carcinogens and the effects of environmental pollutants on these processes. The second area of research involves an investigation of the chemoprotective properties against various human cancers and against cardiovascular diseases by a group of flavonoids present in hops and in beer.

The major class of enzymes involved in the activation of carcinogens is the cytochrome P450s and we have cloned a number of the teleost P450 isoforms from both rainbow trout and zebrafish, expressed the resulting cDNAs from a heterologous expression system and determined the catalytic properties, substrate specificities and kinetics of the resulting recombinant P450 proteins. Related studies also are examining the regulation, tissue and cell localization and the influence of environmental factors on the activities of these enzymes. A special goal of these investigations is to determine why zebrafish are relatively resistant to the effects of carcinogens such as aflatoxin B1 and dibenzo[a,l]pyrene and to develop zebrafish test strains that are more sensitive to such carcinogens.

Several chalcones, flavones and isoflavones from hop flowers have been found to be effective in inhibiting the growth of different human cancer cells (breast, colon and ovarian) in culture. These same flavonoids were shown to inhibit several of the cytochrome P450 isoforms that activate carcinogens and to induce the expression of phase II enzymes such as quinone reductase that detoxify reactive carcinogen metabolites. Similarly, the hop flavonoids were found to be effective antioxidants which suggests that in addition to exhibiting anticancer activities, they may be chemoprotective against cardiovascular diseases such as atherosclerosis. A related study has determined the pharmacokinetics and metabolism of the major hop chalcone, xanthohumol, in rats and with human enzyme preparations.

(2) Research Impacts

Our research on carcinogenic mechanisms using fish models could reveal useful information relating to human cancers and to the development of effective treatment or protection strategies. The hop flavonoid research has provided promising leads on potential chemopreventative agents for use against human cancer and cardiovascular diseases.

(3) Research Outcomes:

Previous research in this laboratory have provided significant support to the Oregon Department of Health's enforcement of legislation requiring all antifreeze and windshield washer fluid sold in the state to contain effective concentrations of an adersive agent (Bitrex).

(4) Integrated Research:

The studies with fish involve a number of collaborators at the University of Oregon's Zebrafish Resource Center, and in California, Mississippi, Maryland and Utah and overseas in Taiwan, Turkey and Germany. In the hop flavonoid area, most of the research has been accomplished in collaboration with Dr. Max L. Deinzer from the Department of Chemistry at OSU, Dr. Balz B. Frei and others at the Linus Pauling Institute at OSU and with other researchers in Maryland, Missouri and Germany.

Recent Publications

HENDERSON, M.C., MIRANDA, C.L., STEVENS, J.F., DEINZER, M.L. and BUHLER, D.R. (2000). In vitro inhibition of human P450 enzymes by prenylated flavonoids from hops, *Humulus lupulus*. *Xenobiotica* 30, 235-252.

- MIRANDA, C.L., APONSO, G.L.M., STEVENS, J.F., DEINZER, M.L. and BUHLER, D.R. (2000). Prenylated chalcones and flavanones as inducers of quinone reductase in mouse Hepa 1c1c7 cells. *Cancer Lett.* 149, 21-29.
- MIRANDA, C.L., STEVENS, J.F., IVANOV, V., MCCALL, M., FREI, B., DEINZER, M.L. and BUHLER, D.R. (2000). Antioxidant and prooxidant actions of prenylated and nonprenylated chalcones and flavonoids in vitro. *J. Agric. Food Chem.* 48, 3876-3884.
- BUHLER, D.R., MIRANDA, C.L., HENDERSON, M.C., YANG, Y.-H., LEE, S.-J., and WANG-BUHLER, J.-L. (2000) Effects of 17 β -estradiol and testosterone on hepatic mRNA/protein levels and catalytic activities of CYP2K1, CYP2M1 and CYP3A27 in rainbow trout (*Oncorhynchus mykiss*). *Toxicol. Appl. Pharmacol.* 168, 91-101.
- NEUMANN, C.M., GIFFIN, S., HALL, R., HENDERSON, M.C. and BUHLER, D.R. (2000). Oregon's toxic household products law. *J. Public Health Policy* 21, 342-359.
- YANG, Y.-H., MIRANDA, C. L., HENDERSON, M.C., WANG-BUHLER, J.-L. and BUHLER, D.R. (2000). Heterologous expression of CYP2K1 and identification of the expressed protein (BV-CYP2K1) as lauric acid (T-1) hydroxylase and aflatoxin B1 exo-epoxidase. *Drug Metab. Dispos.* 28, 1279-1283.
- MIRANDA, C.L., YANG, Y.-H., HENDERSON, M.C., STEVENS, J.F., SANTANA-RIOS, G., DEINZER, M.L. and BUHLER, D.R. (2000). Prenylflavonoids from hops inhibit the metabolic activation of the carcinogenic heterocyclic amine, 2-amino-3-methylimidazo (4, 5-f) quinoline (IQ), mediated by cDNA-expressed human CYP1A2. *Drug Metab. Dispos.* 28, 1297-1302.
- YILMAZER, M., STEVENS, J.F., DEINZER, M.L. and BUHLER, D.R. (2001). In vitro biotransformation of xanthohumol, a flavonoid from hops (*Humulus lupulus*), by rat liver microsomes. *Drug Metab. Dispos.* 29, 223-231.
- YILMAZER, M., STEVENS, J.F. and BUHLER, D.R. (2001). In vitro glucuronidation of xanthohumol, a flavonoid from hops (*Humulus lupulus*), by rat and human liver microsomes. *FEBS Lett.* 491, 252-256.
- RODRIGUEZ, R.J., MIRANDA, C.L., STEVENS, J.F., DEINZER, M.L. and BUHLER, D.R. (2001). Influence of prenylated and non-prenylated flavonoids on liver microsomal lipid peroxidation and oxidative injury in rat hepatocytes. *Food Chem. Toxicol.*, in press.
- WANG-BUHLER, J.-L., LEE, S.-J., YANG, Y.-H., WANG, W.-D., HU, C.-H. AND BUHLER, D.R.(2001). CYP2K6 from zebrafish (*Danio rerio*): Molecular cloning, gene analysis and heterologous expression in a baculovirus system. *The Toxicologist* 60, 404.

Metabolic Relationship Between Selenium and Myopathy

(1) Research Overview

We are investigating the selenium containing protein, Selenoprotein W (SeW), in our laboratory by focusing our research efforts on two aspects of SeW: 1) the differential SeW promoter activity in muscle and brain, and 2) the development of a SeW knockout mouse to investigate function. The purpose of this work is to obtain a more complete understanding of the metabolic functions of selenium and selenoproteins. Mammalian skeletal and cardiac muscle are most affected in selenium deficiency and they are the tissues with the highest SeW content. We believe this is not coincidental. Therefore, the identification of the function of SeW could provide information on disorders of the muscle and heart in humans.

The other focus is on the anticarcinogenic effects of selenium enriched plants, using broccoli florets and sprouts, wild leeks and wheat grains.

(2) Research Impact:

Those individuals interested in the health benefits of selenium will benefit from this research.

(3) Research Outcomes:

We investigated the SeW promoter in rat C6 glial cells and L8 muscle cells. We made various promoter constructs of the rat SeW and used a luciferase reporter for our assays of promoter activity. We truncated the promoter from 2090 bp to 50 bp. We found differential promoter activity in the two cells types. We identified a metallothionein regulatory element in the rodent SeW promoter using computer analysis. When the metallothionein transcription factor binding site is mutated the promoter does not respond to zinc. However, when zinc is added to C6 glial cells transfected with the unmutated promoter, luciferase activity increases suggesting that the SeW promoter is responsive to zinc. We see an increase in promoter activity when glial cells are treated with copper in a 1265 bp promoter construct. We see a difference in promoter response between C6 glial cells and L8 muscle cells.

We are continuing to construct a mouse knockout plasmid, which should be complete within the next two months. After the knockout mice are obtained, metalolic investigations of SeW function will be performed.

Our research with selenium enriched plants indicate that they are effective in reducing chemically induced mammary and colon tumors in laboratory animals. The selenium incorporated into the plant is more effective than inorganic selenium in this tumor reduction. This indicates that either the forms of selenium in the plant or the interactions with other components in the plant are critical for counteracting tumors.

(4) Integrated Research:

We are working with Dr. Walt Ream (Department of microbiology) and Dr. Douglas Barofsky (Department of chemistry) at OSU; Dr. Manfred Baecher (Oregon Health Sciences University) in Portland, OR; and Dr. John Finley (Human Nutrition Research Center) in Grand Forks, North Dakota.

Dietary Inhibition and Promotion of Cancer in the Trout Model

(1) Research Overview

The rainbow trout has proven to be an excellent model for human cancer research. The research supported focuses on the role that dietary phytochemicals play in enhancing or reducing our risk for cancer. The major phytochemical under study is indole-3-carbinol (I3C), a major component of cruciferous vegetables such as broccoli, cauliflower and Brussels sprouts. I3C is also sold as a dietary supplement. In various animal models, when administered prior to and/or with a chemical carcinogen, I3C protects against cancer. Based on these results, I3C is being evaluated by the National Cancer Institute as a chemopreventive agent for healthy women to protect against breast cancer. However, our work in the rainbow trout has raised serious concerns about the long-term use of I3C. When fed to trout for a period of months following treatment with a chemical carcinogen (which more truly approximates human exposures), I3C markedly promotes liver cancer. Our goal is to determine what the relative risk of long-term intake of I3C is to humans and its mechanism of action.

(2) Research Impacts

Over the past year, in pursuit of the above stated goals, we have demonstrated that I3C acts like an estrogen in the trout and that this, in all probability, is the mechanism by which I3C is promoting cancer. These results are highly significant as preliminary evidence from other laboratories suggest that I3C can function as an estrogen in humans. Based on these findings, caution needs to be exercised in the advocacy of the use of I3C in dietary supplementation. The major publications over the last year communicating these results were:

Shilling, A.D. and Williams, D.E. (2000) Determining Relative Estrogenicity by Quantifying Vitellogenin Induction in Rainbow Trout Liver Slices. *Toxicol. Appl. Pharmacol.* 164:330-335.

Shilling, A.D., Carlson, D.B., Katchamart, S. and Williams, D.E. (2001) 3,3'-Diindolyl-methane, a Major Condensation Product of Indole-3-Carbinol, is a Potent Estrogen in the Rainbow Trout. *Toxicol. Appl. Pharmacol.*, 170:191-200.

(3) Research Outcomes

The results from our research have, in part, contributed to recent decisions by the National Cancer Institute to re-evaluate the clinical trials with I3C in healthy women.

(4) Integrated Research

Our work on dietary modulation of toxicity and cancer has lead us to a number of very rewarding collaborations including:

An investigation with Dr. Moussa Diawara at the University of Southern Colorado to study the dietary effects of psoralens (found in celery) in trout and mammals. This past year, we published a paper on the toxicity of these compounds to the liver of mice.

Diawara, M.M., Williams, D.E., Oganessian, A. and Spitsbergen, J. (2000) Dietary Psoralens Induce Hepatotoxicity in C57 Mice. *J. Natural Toxins* 9:179-195.

Utilization of the rainbow trout as a model for determining the carcinogenic potential of fumonisin, a mycotoxin found commonly in corn in the US. Fumonisin are very toxic to livestock, and a number of deaths have resulted from the consumption of contaminated feed. The FDA is utilizing our data and those from a National Toxicology Program two year feeding study in the rat, to determine what the action levels should be for human diets. This work was performed in collaboration with the Mycotoxin Disease laboratory at the USDA in Athens Georgia.

Carlson, D.B., Williams, D.E., Spitsbergen, J., Ross, P.F., Bacon, C.W., Meredith, F.I. and Riley, R.T. (2001) Fumonisin B1 Promotes Aflatoxin B1 and N-Methyl-N'-Nitro-Nitrosoguanidine Initiated Liver Tumors in Rainbow Trout. *Toxicol. Appl. Pharmacol.* 172:29-36.

Riley, R.T., Enongene, E., Voss, K.A., Norred, W.P., Meredith, F.I., Sharma, R.P., Carlson, D.C., Williams, D.E. and Merrill, A.H., Jr. (2000) Spingolipid Perturbations as Mechanisms for Fumonisin Carcinogenesis. *Environm. Hlth. Perspect.*, in press.

Finally, as an outcome of the studies documenting the estrogenic properties of I3C in the trout, we further established the trout model as important for the study of the effects of endocrine active chemicals or xenoestrogens. The FDA and EPA are mandated by Congress to provide testing of chemicals for their estrogenic effects. The results from these studies were published in the following papers:

Carlson, D.B., Curtis, L.R. and Williams, D.E. (2000) Salmonid Sexual Development is not Consistently Altered by Embryonic Exposure to Endocrine-Active Chemicals. *Environm. Hlth. Perspect.* 108:249-255.

Shilling, A.D. and Williams, D.E. (2000) The Non-Aromatizable Androgen, Dihydrotestosterone, Induces Antiestrogenic Responses in the Rainbow Trout. *J. Steroid Biochem. Molec. Biol.* 74:187-194.

Carlson, D.B., and Williams, D.E. (2001) 4-Hydroxy-2',4',6'-trichlorobiphenyl and 4-Hydroxy-2',3',4',5'-tetrachlorobiphenyl are Estrogenic in Rainbow Trout. *Environ. Toxicol. Chem.* 20:351-358.

OSU Program 3: Safe and Effective Management of Pests:

Botany & Plant Pathology

(1) Research Overview

Our work is directed towards designing nematode management strategies for the future of Oregon Agriculture. In order to maintain yields and quality, potato growers in the Pacific Northwest, U.S. must control Columbia root-knot nematode (*Meloidogyne chitwoodi*), stubby-root nematode (*Paratrichodorus allius*) the vector of tobacco rattle virus which causes corky ring spot (CRS) disease, and *Verticillium dahliae*, which contributes to early dying disease. This effort pursues methods to control these problems by cultural management practices such as crop rotations and green manure cover crops as well as through improved use of chemicals so that costs are reduced to growers and less active ingredient is applied to fields.

(2) Research Impacts

These pathogens have been controlled by double fumigation with shank injection of 1,3-dichloropropene (1,3-D) at 20 gpa (which controls nematodes but not *V. dahliae*) plus metam sodium at 38 gpa applied via chemigation (which controls *V. dahliae* but not nematodes). Although double fumigation is effective, it is also expensive. Trials with the two products in combination at reduced rates (15gpa 1,3-D; 30 gpa metam sodium) demonstrated that control could be maintained at a savings of \$100/acre to the grower and a 22% reduction in active ingredient applied. It is estimated that Oregon growers alone will save \$500,000 annually by adopting these new procedures. Cost savings in Washington and Idaho are likely to be much greater. Additional studies revealed that shank injection of metam sodium at 6, 12 and 18 in provided better nematode control than when metam sodium is applied by chemigation. However, when used alone, a higher rate (60 gpa) may be needed for control of *M. chitwoodi*, because more soil volume is treated by this method. A tank mix of metam sodium at 38 gpa plus ethoprop EC at 2 gpa injected at 6 and 12 in provided excellent control of *M. chitwoodi* and CRS.

(3) Research Outcomes

Opportunity to apply will follow completion of the experiment in which discussions with local growers and an ag economist helped design and initiate a four-year crop rotation trial to see if *M. chitwoodi* could be controlled with crop rotation and the use of green manure cover crops while maintaining profitability in the farming system.

(4) Integrated Research

We interact closely with personnel the Oregon branch stations at Klamath Falls and Hermiston as well as with the personnel at the Washington State University Irrigated Agriculture Research and Extension Center in Prosser, WA.

(1) Research Overview

Our goals are focused principally on development and refinement of control methods for fire blight of pear and apple, and to integrate these technologies into commercial fire blight management. A major effort has been devoted to biological control of fire blight with antagonistic bacteria. Also, in recent years we have expanded our activities to include new chemical control strategies, and modifying prediction of fire blight risk for use with softer control strategies. In the last year, we completed a study concerned with understanding how orchard environment affects spread of bacteria from plant to plant. Field trials are conducted annually to evaluate new technologies for suppression of bacterial disease. In addition to antagonistic bacteria, classes of agents being evaluated include clays and stone powders and elicitors of induced host resistance. Strategies to optimize mixtures of strains of antagonistic bacteria also are being tested in the field.

(2) Research Impacts

We seek to control fire blight of pome fruits, which causes significant annual losses to growers of apples and pear in North America, Europe, and New Zealand. The fire blight pathogen blight has become resistant to chemical controls used in the United States. In 1988, in Yakima, the pathogen destroyed many orchards, causing millions of dollars in damage, despite the use of chemical control agents. Similarly, a \$40 million loss, due to fire blight occurred in southwest Michigan in spring 2000.

(3) Research Outcomes

Demonstrated that application of antagonistic bacteria to pear flowers is an effective fire blight control strategy in major pear production areas of the Pacific Northwest.

Developed strategies to integrate biocontrol with conventional management practices.

Provided data that contributed to commercialization of two bacterial antagonists used in our studies.

Furthered the understanding of the ecology of bacterial epiphytes on surfaces of pear and apple flowers.

Developed strategies to optimize mixtures of strains of antagonistic bacteria with resulting levels of disease suppression that approaches the level obtained with a chemical standard.

Developed a model to improve timing of applications of "soft" disease control technologies.

(4) Integrated Research

Collaborations occur with scientists and/or extension faculty affiliated with the Oregon State University Dept. of Horticulture, Washington State University, University of California, and USDA ARS Laboratories in Corvallis, OR and Wenatchee, WA.

(1) Research Overview

This research was to isolate virus infected and uninfected algae from the genus *Ectocarpus* from the coast of Oregon, to demonstrate virus infectivity of the uninfected isolate by EsV, to map this *Ectocarpus* viral genome and to characterize cell cycle involvement in sporangial development with the view toward determining cell cycle control of aberrant virus containing sporangia.

(2) & (3) Research Impacts and Outcomes

Identification, isolation and characterization of algal genes allows subsequent appraisal of their involvement in aberrant viral infected sporangia. Southern blot analysis was used to determine the size of this gene family in algae and to indicate the level of complexity. Genes can be placed in yeast to determine if they complement yeast functions.

(4) Integrated Research

Collaborative research was done with scientists at other institutions.

(1) Research Overview

Development of rapid methods for detecting agrobacteria on or in symptomless plants and callus/tumor tissue. Isolates from tumor samples from apple, cherry, grape, peach, pear, walnut, lilac, hawthorne, persimmon, and plum tree tumors from six California nurseries were purified and tested for hybridization to DNA probes specific for *Agrobacterium* Ti plasmid genes. 17% of the pathogens were biotype 1, 67% biotype 2, 3% biotype 3 and 13% unknown. 47% were sensitive to biocontrol agent K84, 13% to HLB-2,

and 12% to E26; 27% were not sensitive to any antagonist. Growers were advised to use K84 as a preplanting dip.

Evaluation of grape root stocks for resistance to *Agrobacterium vitis*. Isolates from samples sets from 5 rootstocks and 14 grape varieties at 20 sites in Oregon, were probed with DNA and tested for pathogenicity. Of the isolates tested 16% were biotype 1, 14% biotype 2, 58% biotype 3 and 12% unknown. 9% of the pathogens were sensitive to K84, 21% to HLB-2, 17% to E26 and 53% were not sensitive to any antagonist tested.

Evaluation cover crops in combination with solarization for the suppression of soil borne pathogens and weeds in field trials. The effect of cover crops, soil solarization (2 mos) and metam sodium on weeds and pathogen populations showed that *Phytophthora cinnamomi* populations were reduced at all soil depths by solarization or metam, but *V. dahliae* was only reduced at 5 and 10 cm. Population densities of *Pratylenchus penetrans* and *Agrobacteria* decreased in solarized and metam plots, but increased in all cover crops plots. Annual bluegrass emergence was greatly reduced in solarized soil.

(2) Research Impacts

Results have been applied throughout the state.

(3) Research Outcomes

Significant changes in the management of these important bacterial diseases of ornamental plants in Oregon agriculture have been made.

(4) Integrated Research.

Collaborators at OSU, Oregon and nationally.

(1) Research Overview

The effects of host genotype on aggressiveness and sexual reproduction of *Mycosphaerella graminicola* (causal agent of *Septoria tritici* blotch of wheat) were studied. In contrast to preliminary data, we found that populations of the pathogen collected from susceptible host genotypes in the field were not more aggressive than those collected from partially resistant genotypes. Populations of *M. graminicola* sampled from cultivar mixtures were less aggressive than those collected from single cultivars. Susceptible wheat cultivars harbored more sexual fruiting bodies than did partially resistant wheat cultivars; evidence suggests that this may be due to an increased contact between opposite mating types on the more highly diseased, susceptible cultivars.

(2) & (3) Research Impacts and Outcomes

This information will be useful to wheat breeders and wheat farmers, who are striving to obtain more durable resistance to *Septoria tritici* blotch. Mixture of cultivars has been adopted in eastern Oregon for control of stripe rust on wheat and the possibility of similar application for control of *Septoria* can be considered.

(4) Integrated Research

Collaborators at OSU, nationally and internationally.

(1) Research Overview

When late blight emerged as a major disease limiting potato production throughout North America in early 1990, the only effective management practice was repeated foliar applications of a protectant fungicide. The source of inoculum for these late blight epidemics was attributed to cull piles and volunteer potatoes. Today, the seed piece is regarded as the major means by which the disease is introduced into a planting.

(2) & (3) Research Impacts and Outcomes

Research has found that seed borne late blight can be successfully managed with two tactics: seed treatment and a foliar fungicide at emergence. The objective of seed treatment with a product with activity against late blight is twofold: (1) to prevent transmission of the pathogen from the seed piece to the emerging plant and (2) to increase the overall stand and vigor of the planting. Banding of a fungicide with curative activity when plants are 5 to 7 inches tall and again 4 to 7 days later targets the first cycle of disease. The goal is to stop the spread of the disease before it becomes established in the planting. Both of these disease management tactics are effective, economical, sustainable, and environmentally friendly.

(4) Integrated Research

Cooperative efforts: Dr. Debra A. Inglis, Washington State University

(1) Research Overview

The overall objective of the studies conducted in our laboratory is to understand what changes occur in a plant host as a consequence of microbial infection that results in the expression of either disease resistance or susceptibility. A major component of these studies has involved an investigation of a disease called Victoria blight of oats that is caused by a host selective toxin-producing fungus, *Cochliobolus victoriae*. Toxin production by the fungus is required for pathogenesis. In the host, toxin sensitivity and consequently, disease susceptibility, is controlled by the dominant Vb gene and homozygous recessive plants are both toxin insensitive and resistant to the fungus. Thus, the effect of toxin appears to dictate susceptibility in this interaction. Furthermore, the Vb gene cannot be genetically resolved from the Pc-2 gene, which confers resistance to the crown rust pathogen, *Puccinia coronata* and mutations in toxin sensitivity simultaneously affect rust resistance. Thus, it appears that the Vb gene and the Pc-2 gene may be identical. These observations indicate that the toxin can elicit both disease resistance and susceptibility responses. Recently, we have shown that the toxin, victorin, induces a programmed cell death (PCD) response that shares the characteristics of apoptosis. Consequently, understanding how victorin acts should provide insight into both plant disease resistance and susceptibility and an event perhaps more fundamental, the regulation of PCD. Apoptosis, a genetically-controlled, organized form of cellular disassembly is distinct from necrosis and displays discrete morphological and biochemical characteristics. Because of its importance, it has become one of the most studied phenomena of contemporary animal biology. Recently, it has been implicated in a number of fundamentally important plant processes including the hypersensitive resistance response (HR) to pathogens. Nevertheless, it has not been extensively investigated in plants. We have found that victorin, produced by *C. victoriae*, induces an apoptotic-like response in toxin-sensitive, blight susceptible oats. The characteristics of this response include cell shrinkage, DNA "laddering", mitochondrial depolarization, and the induction of a protease cascade that appears to involve proteases with caspase-like activity. Investigations of animal apoptosis have demonstrated that mitochondria, through regulation of the mitochondrial transition pore (TP) are central mediators of the apoptotic response. Investigations of the mode of action of victorin have shown that victorin binds to the mitochondrial, glycine decarboxylase complex (GDC) and that binding appears to contribute to symptom development. We have also shown that oat mitochondria have a TP-like pore which when induced to open allows victorin binding to the GDC. Furthermore, in vivo analyses of mitochondrial potential supports the likelihood that this TP-like pore is induced to open during victorin-induced cell death in oats. Consequently, it is likely that victorin binding to the GDC occurs via the TP which contributes to cell death by exacerbating mitochondrial dysfunction.

However, it is becoming clear that the GDC does not represent the primary site of action of victorin. This site, that determines toxin specificity, is the likely product of the Vb gene. To facilitate a genetic approach, we have identified toxin sensitivity in the model plant *Arabidopsis thaliana*. Segregation analysis has demonstrated that victorin sensitivity in *Arabidopsis*, as in oats, is controlled by a single dominant gene that we have tentatively named AVb. The discovery of victorin sensitivity in the model plant, *Arabidopsis thaliana* will facilitate a comprehensive genetical and molecular genetical evaluation of the victorin induced host response.

(2) Research Impacts

This is basic research and will impact our understanding of plant disease resistance and susceptibility and our understanding of programmed cell death in plants. This latter subject is important in not only disease but also normal plant processes such as senescence and development.

(3) Research Outcomes

The research is providing fundamental understanding of plant disease and programmed cell death.

(4) Integrated Research

We collaborate on a number of programs with researchers here at Oregon State University and other institutions in the United States.

(1) Research Overview

The research deals with research on insect and mite pests of tree fruit and nut crops in western Oregon. The major aims are to develop better understanding of pest and natural enemy biology and ecology, and to formulate and implement comprehensive insect pest management programs. The major approaches include efficacious use of chemicals and increasing implementation of biological control in crop systems.

2) Research Impact

The major beneficiary of the research conducted are Oregon growers who struggle on a yearly basis to control pests in tree fruit and nut crop systems. Development of more advanced systems to better monitor and control pests will enhance their ability to control pests and improve profitability. The science of entomology also benefits as new discoveries in insect biology, behavior, ecology and management are developed.

3) Research Outcomes

Newer insecticides including IJR's (insect growth regulators) and softer insecticides like Neem were tested with highly encouraging results. The Neem products are now registered for use against a number of hazelnut pests. The insect growth regulators are still being tested. If registered, they can provide effective control of major pests with least disruption of natural enemies. The classical biological control program against filbert aphids has been exceedingly successful throughout Oregon orchards. Over ten million dollars worth of economic benefit has been achieved by this research during the past 10 years.

4) Integrated Research

The Oregon State University Extension Service is deeply involved with our research. Most of the research data developed are the result of cooperative work of the past years. We are currently cooperating with Extension Agents investigating the parasite, *Trioxys pallidus* biology and management of filbertworm. We also cooperate with entomologists at Washington State University and overseas cooperators in such countries as Greece, Turkey, Italy and Spain.

Biology and Management of Arthropods In Peppermint

(1) Research Overview

Research on the biology management of arthropods on peppermint has two primary objectives: 1) develop an online decision support system for Integrated Pest Management on Peppermint - IPMP version 3.0 and 2) develop methods to rear and store indigenous beneficial nematodes for biological control of soil insects in mint. The following information represents accomplishments in 2000.

(2) & (3) & (4) Research Impacts, Outcomes and Integrated Research

Objective 1: The web version of Integrated Pest Management on Peppermint (IPMP3.0) is being developed in cooperation with Len Coop, Research Associate, and Marcos Kogan, Integrated Plant Protection Center at Oregon State University. Funding is provided by the Oregon Mint Commission and the Mint Industry Research Council. IPMP3.0 will provide online information about the management of pests on mint to growers, County Agents, researchers, extension specialists, and consultants throughout the Pacific Northwest. Since initiating this research we have completed the Insect Management section, except for making the final links to the dynamic insect sampling and phenology models. The publication on nematode biology and management in mint (IPPC Publication No. 996) written by Russ Ingham and Kathy Merrifield (Department of Botany and Plant Pathology) has been incorporated into the Nematode Management section. The Disease Management section has been completed with links to the PNW Disease Control web page in Department of Botany and Plant Pathology. The section on Weed Management is currently under development in cooperation with Carol Mallory-Smith and Jed Colquhoun the Department of Crop and Soil Science. Insect dynamic application tools including phenology models, sampling and threshold calculators, and the MINTSIM mint defoliation/simulation model will be included on the site. Hosting these models over the web greatly enhances their convenience and ease of use by allowing automatic linking to near-real time weather data - currently there are more than 300 weather stations available throughout Oregon, Washington, Idaho, and Montana. In addition, 7-day weather forecasts and historical average weather data will greatly improve the utility of these degree-day models. The completed web site will have the following url: <http://mint.ippc.orst.edu>.

Objective 2: This goal is to develop methods to rear commercial quantities of an entomopathogenic nematode for biological control of insects associated with mint. We have successfully developed a protocol for rearing the bacteria (*Photobacterium luminescens*) of the entomopathogenic nematode *Heterorhabditis marelatus* Liu and Berry, which was originally described from the Oregon Coast. We are presently using a small 1-liter bioreactor (fermenter) containing a defined growth medium designed to culture the bacterium. We have developed standard growth curves for the bacterium since this step is the most critical to the successful mass production of *H. marelatus*. We are continuing our studies using the bioreactor to investigate nematode growth in conjunction with the bacterium and to modify culture conditions (dissolved O₂ levels, pH, media composition, and temperature) to maximize production of bacteria and *H. marelatus*. This work is in cooperation with Frank Chaplen, Department of Bioresource Engineering.

Safe and Effective Management of Pests

(1) Research Overview

I work with the commercial nursery and Christmas tree industries in insect and mite pest management. My focus is on helping growers to correctly identify pest problems and then to apply safe and effective control/management.

(2) & (3) Research Impacts and Outcomes

Benefits directly accrue to growers through reduced production costs and to consumers and agricultural workers through reduced exposure to insecticides and miticides.

(4) Integrated Research

North Willamette Agricultural Research and Extension Center

(1) & (2) & (3) Research Overview, Impacts and Outcomes

On-going studies of *Marchantia* control in container nursery production systems indicated that no nursery-labeled herbicides are presently effective for controlling this weed when standard nursery practices are used. *Marchantia* collected from nursery sites was more resistant to herbicides compared to *Marchantia* collected from landscapes. A non-herbicide procedure using seed meal from *Limnanthes alba* was developed, and successfully replicated at commercial nursery sites. A herbicide used internationally (quinclamine) provided nearly complete control of *Marchantia* in several experiments, but the Japanese manufacturer has no plans to submit the product for release in the United States. Cinnamic aldehyde provided very good control of *Marchantia*, but there is some risk of phytotoxicity to nursery crops under certain weather conditions. Nursery-labeled herbicides provided some control of *Marchantia* if cultural procedures, such as reduced irrigation frequencies, were also used. *Marchantia* establishment was shown to increase as irrigation, nitrogen, or phosphorus applications increased. Surface applications of controlled-release fertilizers increased the establishment of *Marchantia* in container production systems.

(4) Integrated Research

Mid Columbia Agricultural Research and Extension Center

(1) & (2) & (3) Research Overview, Impacts and Outcomes

On apples, six applications of the neonicotinyl insecticide thiacloprid were as effective as four applications of azinphosmethyl for control of codling moth. Two sprays of thiacloprid against the second generation were equal to three or four sprays. Thiacloprid did not control San Jose scale. Codling moth control with the IGRs tebufenozide and methoxyfenozide was inferior to azinphosmethyl. Some thiacloprid treatments had elevated spider mite levels. Bifenazate controlled spider mites but not rust mites on apple and was comparable in effectiveness to pyridaben. On pears, indoxacarb controlled leafrollers and codling moth control was similar to a standard phosmet program. Pyriproxyfen applied around bloom time (pink, petal fall) for pear psylla control was more effective than earlier timings (delayed dormant). Pyridaben applied at pink assisted by natural enemies during late spring and summer provided season-long pear psylla control. In laboratory tests, pyriproxyfen and pyridaben were more effective ovicides against pear psylla than either amitraz, imidacloprid, or abamectin. In field tests, horticultural mineral oil (HMO) improved the activity of imidacloprid against pear psylla but not of pyridaben. Pear thrips emerged over a 4-6 week period beginning in mid-March. Spinosad applied during bloom controlled pear thrips on apples and cherries similar to formetanate. Foliar applications (handgun) of HMO at 1% affected fruit size and return bloom on pear. No effect was noted with airblast treatments after the third year. In release experiments, codling moth adults were positively attracted to pear and apple trees but not to a non-host such as maple.

Presence of fruit increased oviposition activity. Resistance in some pear cultivars to codling moth was related to inability of neonates to enter fruit. Field tests on cherries suggest that spinosad may be a potential replacement for chlorpyrifos for pre-bloom leafroller control. Methoxyfenozide was as effective as Bt for control of summer generation leafroller larvae.

(4) Integrated Research

(1) Research Overview

The overall objective of this research is to develop effective integrated control procedures for major preharvest and postharvest diseases of tree fruits in the Pacific Northwest. Our goals include i) development of a model for pear scab leaf and fruit infection and ascospore maturity, ii) determine the optimum timing of fungicide applications for control of bull's-eye rot of pear, iii) study the epidemiology of *Botrytis cinerea* (cause of gray mold), and iv) commercialize the OSU-patented yeast *Cryptococcus infirmo-miniatus* (CIM) for control of postharvest decay of fruit crops.

(2) Research Impacts

The pear scab model is being expanded and validated in Hood River and Medford. It has been added to the IPPC website and will benefit pear growers from northern California to western Washington. The bull's-eye and gray mold research is still in progress. The yeast, CIM, has been patented and is licensed to Ecogen, Inc. for commercialization. Once registered with the EPA, it will be used on stored apples, pears, and sweet cherries.

(3) Research Outcomes

Pear scab is being controlled with reduced fungicide usage in Hood River. Reduced fungicide programs will be initiated in Medford, the Willamette Valley, and western Washington once model validation is complete.

(4) Integrated Research

The pear scab model is being validated in cooperation with Dr. David Sugar (Southern Ag Research and Ext. Ctr.) and Miguel Ahumada (Bear Creek Orchards, Medford). Bull's-eye research is being done in cooperation with Dr. David Sugar and Dr. Jim Rahe (Simon Fraser University). CIM currently is licensed to Ecogen, Inc. (Langhorne, PA).

Southern Oregon Research and Extension Center

(1) Research Overview

The goal of this research is to develop a storage decay control strategy for winter pears in which diverse, independent decay control practices contribute to dependable reduction of postharvest diseases. Stored pears are attacked by several distinct fungal pathogens adapted to infect under low temperature and low oxygen conditions. Techniques are being developed to enhance fruit resistance to infection, interfere with pathogen growth, and reduce the competitive ability of pathogens to successfully infect fruit.

(2) Research Impacts

Methods developed are being implemented by pear growers, who deliver fruit to packinghouses with greater resistance to postharvest decay, and by packinghouse and storage operators, who complement this by applying treatments and managing storage conditions to reduce the risk of decay.

(3) Research Outcomes

A sequential orchard treatment program utilizing nutritional, chemical and biological methods has been demonstrated to be an effective application of the concepts developed in this research. Calcium chloride sprays in mid-summer, followed by ziram fungicide 2-4 weeks before harvest, then yeast biocontrol sprays one week before harvest reduce decay by distinct mechanisms. Yeast biocontrol, however, is more effective if applied in the packinghouse; a commercial product is currently available, and new products based on yeasts evaluated are forthcoming. Calcium chloride can also be used as a flotation salt for pears and enhance decay control at fruit wounds occurring during harvest and handling. Potential new fungicides that are highly effective against postharvest pear decays and classified as "reduced risk" by EPA have been evaluated and optimum use patterns identified, including integration with biocontrol. Elevated CO₂ in storage room atmospheres is being used by some storage operators following research results showing decay suppression and quality enhancement. Modified atmosphere packaging (MAP) bags can contribute to decay suppression by accumulating CO₂ and fruit volatiles within the bag; commercial use of these bags for pears was extensive in the 2000 crop year.

(4) Integrated Research

This research has involved cooperation with scientists at the OSU Mid-Columbia Agricultural Research and Extension Center as well as at Washington State University, the University of California, the Washington Tree Fruit Research Commission, and USDA.

Columbia Basin Agricultural Research Center

(1) Research Overview

This research develops methods for improved management of weeds in Oregon dryland crops, primarily wheat, including such practices as new crop rotation techniques, improved fertilization and tillage, and use of newer, safer, chemical herbicides, combined with a better understanding of the biology of important weeds.

2) Research Impacts

This effort develops methods for improved management of weeds in Oregon dryland crops, primarily wheat. Research has demonstrated the benefits of new crop rotation techniques, improved fertilization and tillage, and use of newer, safer, chemical herbicides for managing weeds. Impacts include improved crop yields, minimized environmental problems, such as soil erosion and over-use of herbicides, and improved the profitability and sustainability of Oregon's dryland agricultural region. Positive environmental benefits from improved weed management techniques include decreased use of herbicides, reduced nitrogen fertilizer loss from agricultural soils, and less herbicide drift and soil residue loss. In some cases where an increase in herbicide applications is needed, no adverse environmental impact is likely.

3) Research Outcomes

Other researchers build on the knowledge base generated by this program to improve weed management strategies in other geographic locations. The primary target groups include dryland crop producers and technical support personnel in the agri-service industry who have changed weed management practices as a result of research findings.

The ultimate impact is envisioned to be reduced waste in agricultural chemical and fertilizer use, increased diversification and intensification of dryland crop production, with a concomitant increase in farm income while decreasing the negative environmental impacts from soil erosion, off-site pesticide movement, and nitrate movement into water.

4) Integrated Research

Cooperative research is currently being conducted with weed scientists from the University of Idaho, Washington State University, Utah State University, and University of Nebraska. Within Oregon State University, cooperative research is currently conducted with the weed scientist in the Crop and Soil Sciences Department. Other cooperating institutions or agencies include the Oregon Wheat Commission; USDA-CSREES STEEP III Program; CSREES Jointed Goatgrass Research Program; Oregon Department of Agriculture, Alternatives to Field Burning Program; Washington State Commission on Pesticide Registration; DuPont, Inc.; BASF Corp.; FMC Corp.; Bayer, Inc.; Monsanto Inc.

(1) Research Overview

A major objective is to investigate the biology and control of root, crown and culm diseases of wheat and barley. We are currently quantifying damage to cereals caused by root-infecting fungi and parasitic nematodes as growers move through a transition from a two-year winter wheat/summer fallow rotation to more ecologically acceptable annual cropping systems. Specifically, we are identifying yield constraints from root lesion nematode, and have moved past that point to a current emphasis on identifying wheat germplasm with resistance to Fusarium crown rot and cereal cyst nematode. This work is conducted through field studies on commercial farms as well as land administered by the Oregon Agricultural Experiment Station.

(2) Research Impacts

Comparisons of wheat varieties grown in relatively pathogen-free soil that was either inoculated or not inoculated with *Fusarium pseudograminearum* showed that this pathogen could reduce yield from 2 to 30 percent, depending on the winter wheat variety or breeding line produced. The most widely produced variety in Oregon sustained a yield reduction of 21 percent in this study, indicating considerable room for improvement if initial results are stable over years, and the information is adequately communicated to growers and their advisors. Also, a survey during 2000 illustrated that in 20 percent of fields tested the population of root lesion nematodes exceeded the threshold above which economic damage occurs elsewhere in the world. All such fields were annually cropped, including fields of wheat or barley that followed broad-leaf crops (such as canola or lupin) planted to break the cycle of diseases caused by root-infecting fungi. These findings show that there are potential benefits to be attained through breeding cereals for resistance to these pathogens. Toward that end, germplasm with known levels of resistance to Fusarium crown rot, root lesion nematode, and cereal cyst nematode were imported from Australia and are being compared with domestic varieties during 2001.

(3) Research Outcomes

It is too early to judge potential outcomes from this research.

(4) Integrated Research

This work is jointly funded in collaboration with:

- 1). Wheat breeders at OSU (Corvallis) and WSU (Pullman);
- 2). Plant pathologists at WSU (Pullman), USDA-ARS (Pullman), UI (Kimberley), South Australian Research and Development Institute (SARDI; Adelaide, SA), and Queensland Department of Primary Industries (QDPI; Toowoomba, QLD); and
- 3). Nematologists at OSU (Corvallis), SARDI (Adelaide, SA), and QDPI (Toowoomba, QLD).

Coastal Oregon Marine Experiment Station

The Effects of Infectious Diseases on Finfish and Shellfish Populations

(1) Research Overview

Diseases of finfish: We have performed laboratory experiments to assess the factors involved in the initial dissemination of two important fish pathogens: *Aeromonas salmonicida*, the agent of furunculosis in salmon and ornamental fishes, and infectious hematopoietic necrosis virus, the agent of IHN in salmon and trout. We determined the threshold (minimum) density needed to initiate disease and mortality in Chinook salmon and rainbow trout. This can be used in hatcheries to disperse fish to low enough densities to prevent epidemics and in determining the potential effects of pathogens on populations of wild fishes. This could have significant economic benefits if it alleviated the direct loss of fish or reduced the use of antibiotics to treat bacterial diseases of fish.

Modeling of diseases: We have begun to construct models to estimate the risk of causing diseases in wild populations of fish by the introduction of a single infected individual to susceptible population. These have been drawn up around rivers in northeastern Oregon and adjacent Nevada for whirling disease of salmonids. The use of risk assessment models of disease will help in determining where and if potentially infected fish can be released. The economic benefits are not yet estimated, but its influence on distribution of fish could be considerable.

(2) & (3) Research Impacts and Outcomes

Diseases of finfish: This could have significant economic benefits if it alleviated the direct loss of fish or reduced the use of antibiotics to treat bacterial diseases of fish.

Modeling of diseases: The economic benefits are not yet estimated, but its influence on distribution of fish could be considerable.

(4) Integrated Research and Cooperation

Integrated research with the OSU Department of Microbiology, University of Idaho, Oregon Department of Fish & Wildlife, Washington Department of Fish & Wildlife, Nevada Department of Conservation & Natural Resources, California Department of Fish & Game, other agencies throughout the West.

Central Oregon Agricultural Research Center

Vegetable and Grass Seed Production

(2) & (3) Research Impacts and Outcomes

Vegetable Seed Production

Vegetable seed production has been a specialty niche for the Madras area, with current production of seed garlic moving into Crook County as the industry continues the search for new ground without the threat of white rot. In addition to garlic grown for seed, 80 percent of the national hybrid carrot seed supply, onions, radish, coriander, and a variety of other vegetable, herb, and flower seed crops are grown in central Oregon. A major challenge to the industry is availability of pesticides to protect crops from disease, weeds, and insects. Prevention of field contamination due to cross-pollination is also vital to the industry.

Grass Seed Production

Rough bluegrass production acreage has steadily increased compared to traditional Kentucky bluegrass production in the area, and now accounts for two-thirds of the production acreage. This has created a contamination problem for Kentucky bluegrass where high quality seed used by the turf industry. Disease concerns for the Kentucky bluegrass industry include ergot, powdery mildew and stripe rust.

Peppermint Production

Peppermint producers experience a wide array of insect, disease and weed control issues. The biggest concern is with verticillium wilt, which builds in the soil taking ground out of production. Spider mites, strawberry root weevil, cutworms, and flea beetle must be closely monitored. Adequate, timely weed control is vital to a profitable operation.

(2) & (3) Research Impacts and Outcomes

Vegetable Seed Production Research is conducted on vegetable and grass seed crops to evaluate and document the performance of herbicides, fungicides, and insecticides that fill niches where there are currently no effective materials registered. This research is conducted in cooperation with the Jefferson County Seed Growers Association. A per-acre fee on vegetable seed crops was established in 1995 to fund research. Leadership is provided in the registration process, which involves working with manufacturers and the Oregon Department of Agriculture in meeting the necessary state and federal requirements. As a result of these efforts, Orthene was registered for lygus control on seed carrots after bee removal in 1993, and later expanded to include control of green peach aphids in 1995. Ergot control was added to the Tilt fungicide label for Kentucky bluegrass in 1995, and the rate increased from four to eight ounces per acre as a result of phytotoxicity data generated by this research. Ramrod herbicide was registered for use on seed onions in 1995. Lorsban insecticide can be used on seed carrots since 1995. Dual herbicide was registered for use on seed radishes in 1995. Registration of Express herbicide for use on grass seed was received during 1996. Beacon was registered for use on first year Kentucky bluegrass fields in 1996. Seed onions grown in Oregon were added to the Benlate label in 1997. Caparol was registered for use on seed carrots and parsley for weed control in 1998, with a fall application added to the label in 2000.

Grass Seed Production

Extensive fungicide evaluations have been conducted during 1999 and 2000 for control of powdery mildew in Kentucky bluegrass. The product of choice is not longer available and there are several new materials on the market that are unfamiliar to the industry. Evaluation of their effectiveness has provided unbiased, research-based information so industry representatives and growers can make good management decisions. There is strong evidence that fieldmen and growers are using this information as some of the standard materials are no longer available and they must move to newly-registered fungicides, and the adopting more effective products than those they have been using.

Peppermint Production

A weekly faxed update on the development of four peppermint insect pests (mint root borer, mint flea beetle, strawberry root weevil, variegated cutworm) is provided to fieldmen on a seasonal basis to assist growers in the detection and timely control of these pests. This information reduces untimely applications that increase production costs and are not effective in the control of these pests.

(4) Integrated Research

Most research has included industry representative involvement in identifying appropriate locations, as active participants in determining treatments to be evaluated, or providing a lead role in the research. Cooperative work with other Oregon State University faculty include Peter Sexton, Fred Crowe, John Hart, Ralph Berry, Glenn Fisher, and Steve Alderman at the NFSPRC.

Funding from the Grass Seed Cropping Systems for Sustainable Agriculture supports a cooperative program with us and William Johnston, Washington State University. We address diseases and insects in dryland and irrigated cropping systems without grass burning. Additional cooperators are Steve Alderman, Plant Pathologist at USDA-ARS NFSPRC and Paul Hammond, OSU Entomology Department.

Steve Alderman has also been a strong cooperator on local ergot research. Ralph Berry OSU Research Entomologist has been extremely helpful on two multi-year entomology-related projects. The USDA-ARS Bee Biology and Systematics Lab in Logan, UT cooperated in response to a request to evaluate leafcutter bees as pollinators on vegetable seed crops in central Oregon.

Management of Verticillium Wilt of Peppermint with Cultural Controls

(1) Research Overview

For peppermint, *Verticillium dahliae* (VD) reproduces in stems, even though the fungus must be incorporated into soil for root infection in subsequent years. Post-harvest propane flaming of mint stems (to kill the fungus) followed by no fall or spring tillage (to keep remaining inoculum away from roots) is effective in controlling wilt in milder areas of Oregon but was not accepted nor tested in Central Oregon. Growers believed tillage of rhizomes was important for winter survival. Additionally, it was not known whether stem reproduction and flaming/tillage responses on newer varieties were similar to that found on the long-established industry standard. For garlic and onions, soil inoculum of *Sclerotium cepivorum*, the *Allium* white rot fungus, was reduced in 1988-93 trials as effectively with petroleum-sourced germination stimulants or Methyl Bromide (MeBr). Research was conducted to determine whether equal control could be achieved with natural products such as dehydrated garlic powder. We theorized fungicide applications might prove more efficacious against reduced populations of the white rot fungus.

(2) Research Impacts

We hope to preserve the peppermint industry in central Oregon and in other regions in which sustained production is threatened by increasing soil populations of the VD. In central Oregon, peppermint acreage was as high as 25,000 acres but had shrunk to around 14,000 by 1994 and less than 10,000 by 1999, partly due to verticillium wilt intensification. In addition, because this disease is a national problem, this work has national interest and is supported by state and national mint industry funds. We hoped to preserve the onion seed and garlic seed production in central Oregon, along with *Allium* production statewide and through all the Western U.S. and in many parts of the world – this white rot work has true international interest, and research is funded by onion and garlic groups throughout the Western U.S., the USDA, by international industry groups in other countries.

(3) Research Outcomes

On peppermint, flaming combined with no tillage successfully extended current mint stand longevity, and kept inoculum from building to reduce the longevity of future plantings. We demonstrated that winterkill was a result of high verticillium populations, not shallow rhizome placement; thus, flaming and no tillage combined to lessen future winter kill (by keeping high populations from developing) rather than exacerbated current winter kill. Newer varieties did not allow buildup of as much inoculum as the old standard variety. On onions and garlic, dehydrated garlic powder was fully as effective as MeBr and other sources of germination stimulants in reducing soil populations of the white rot fungus. Fungicide efficacy was greatly improved when such high populations were reduced, but we also demonstrated that some new fungicides were moderately effective against high soil populations, too.

(4) Integrated Research

Mint research was not highly integrated with other cooperators elsewhere, although the principles of the findings do apply in many parts of Oregon, California, Washington and Idaho. The onion and garlic research involved close cooperation with scientists and industry reps from Washington, Idaho, California, Mexico, Australia, New Zealand, and Canada. Many local efforts are being made to provide integrated control of white rot based on our findings.

Horticulture

(1) Research Overview

The Weed Science Program provides research on the management of weeds in agronomic and horticultural crops.

Management strategies include chemical and nonchemical methods that will improve grower profitability with the goal of reducing environmental impact.

(2) Research Impacts

Research is being conducted to address the movement of genes between crops and weeds. It is an area of interest, nationally and internationally, for the production of transgenic crops. It is the study of evolution under field conditions and addresses speciation. We have studied introgression between jointed goatgrass, a weed, and wheat. It had been a commonly held belief that if the two species did cross, the plants would be sterile. We have shown in greenhouse and field studies that this is not the case and that viable seed are produced. We also have shown that self-fertility is restored in backcross generations. These are significant findings that have extremely important implications for the development of herbicide resistant wheat and the risk of resistance genes moving from wheat into a weed. We have surveyed wheat fields in Oregon and have found hybrids under field conditions

(3) Research Outcomes

Research was initiated to develop pest management strategies for irrigated row crop production that promote systems and biological diversity. Studies were established to evaluate the change in weed populations and the weed seed banks that occur with tillage rotation. Tillage rotations are implicit in most crop rotations, but often unrecognized as a unique rotational component. Our research demonstrated that early season weed emergence in snap beans and sweet corn can be reduced by 90 to 95% by planting through undisturbed cover crop residue and into untilled seedbeds.

(4) Integrated Research

This research has cooperative research studies with the University of Idaho and Washington State University.

Microbiology

(1) Research Overview

This research examines the role of tRNA mimicry in the replication of the viral genomes of turnip yellow mosaic and related viruses. Preliminary results indicate that this region is involved in a tight interaction with a protein (translation elongation factor eEF1A) that regulates access to the start site of RNA replication.

(2) Research Impacts

This research should provide an understanding of viral replication and thus, provide some approaches to interfere with viral replication. We may be able to develop antiviral components for crop protection.

(3) Research Outcomes

The research has provided training for students and employment for highly trained scientists.

(4) Integrated Research

Collaborating with following groups: Institute for Molecular Plant Research, Strasbourg, France. Dept. of Chemistry and Biochemistry, Univ. of Colorado; and Ukraine National Academy of Sciences, Kiev, Ukraine.

(1) Research Overview

Objectives to investigate bacterial kidney disease (BKD). Groups of juvenile spring Chinook were challenged with *R. salmoninarum* and three antibiotics (oxytetracycline, erythromycin and potentiated sulf-Romet 30) were tested by administration in the feed for efficacy in controlling resulting disease.

(2) Research Impact

The study shows promise for development of prophylactic treatments of salmonids in hatcheries to reduce the impact of this prevalent, chronic disease.

(3) Research Outcome

The Oregon Department of Fish and Wildlife personnel have started to use antibiotic prophylaxis strategies to control valuable captive brood stock for endangered strains of salmon.

(4) Integrated Research

This study is directly integrated with strategies for control of disease in Oregon Department of Fish and Wildlife hatcheries.

(1) Research Overview

This research over the past year has focused on two putative vaccinia virus proteinases, the GIL and 17L gene products, with their role in viral replication cycle and as potential targets for antiviral drug development.

(2) Research Impacts

Research impacts will provide a source of biological active enzyme for use in designing high-throughput screening assays.

(3) Research Outcomes

The research has provided training for undergraduates and graduate students; technical assistants, and faculty research scholars.

(4) Integrated Research

Collaboration with the National Institute of Health, SIGA Research Laboratories, and the University of Florida.

(1) Research Overview

This research examined two different subunit vaccines; one containing an epitope of the IHNV glycoprotein expressed as a fusion protein and the other a DNA vaccine for IHNV. A comparison of vaccine efficacy was conducted.

(2) Research Impacts

The DNA vaccine was, by far, the most effective vaccine. It could induce protective immunity against lethal viral challenge in 85-90% of the fish.

(3) Research Outcomes

The research has provided training for undergraduate and graduate students, senior faculty research associates and faculty scholars. A patent has been filed.

(4) Integrated Research

Collaboration with the University of Connecticut.

(1) Research Overview

Evaluation of a subunit vaccine for IPNV. The vaccination trials employing recombinant DNA derived vaccines encoding the entire A segment of the virus were very effective in protecting fish against lethal challenge with live virus.

(2) Research Impact

The work enables us to understand how the virus processes its coat protein for presentation on the virus surface. The study led to a determination of the important immunogenic epitopes.

(3) Research Outcomes

The research has provided employment opportunities for graduate students, faculty research assistants and associates. Several SBIR grants were funded.

(4) Integrated Research

Collaboration with Hokkaido University in Japan.

(1) Research Overview

Agrobacterium tumefaciens was used to insert foreign genes into plants as it provides proteins that protect transferred DNA from rearrangements. VirE2 is the most abundant *A. tumefaciens* protein that accompanies DNA into plants, where it binds single-stranded DNA transferred from *Agrobacterium*. Crown gall tumors result from expression of three *A. tumefaciens* oncogenes in plant cells.

(2) Research Impact

Research impacts indicate that transgenes have been introduced into apple, and testing the roots for crown gall.

(3) Research Outcomes

Research provided training for undergraduate and graduate students and faculty research assistants.

(4) Integrated Research

Collaboration with Department of Microbiology and Molecular and Cellular Biology Departments, Oregon State University.

(1) Research Overview

Baculoviruses are used as expression vectors to over express genes cloned under certain promoter elements and are currently being studied for development as a new generation of insecticide.

(2) Research Impact

Research impacts are in the basic stage. The viruses we investigate are pathogenic for forest insects and long-term the research will assist in understanding how baculoviruses infect insects and in adapting them to be more efficient as biological control agents.

(3) Research Outcomes

Provides training for undergraduate and graduate students, faculty scholars and faculty research associates.

(4) Integrated Research

Collaboration with laboratories in the Department of Microbiology and Biochemistry and Biophysics, Oregon State University.

Hermiston Agricultural Research and Extension Center

Integrated Pest Management of Insects and Vectored Diseases of Horticultural and Potato Crops in Oregon

Control Mechanisms for Integrated Pest Management of Virus, Aphid, Colorado Potato Beetle, Wireworm and Mites of Potato

(1) Research Overview

We will develop knowledge, based on Pacific Northwest potato growing conditions, that improve ability of commercial growers to control insect pests of potatoes, and support pesticide manufacturers in registering new insecticides for control of green peach aphid, Colorado potato beetle, wireworm, and mite pests of PNW potato.

Columbia Basin (Washington and Oregon) growers rely on more insecticides applied per acre of potatoes than do growers in any other region. The majority of the insecticides used are organophosphate and carbamate insecticides; compounds at risk of cancellation due to the Food Quality Protection Act. Experts recently have estimated that some organophosphate and carbamate use patterns may be canceled within 5 years. Due to the high consumption of potatoes, particularly by children, the large volume of insecticides used, and the number of FQPA insecticides used, potatoes are one of the U.S.

crops most severely impacted by the Act. It is quite likely that multiple chemicals, currently considered critical to potato production in the Pacific Northwest and the United States, will not be available in the near future.

There are many products that have been recently registered, are about to be registered, or are in the process of being registered. There is little data available on the efficacy of many of these products when used in Pacific Northwest use patterns and growing conditions. For example, there is very little data on whether these chemicals control these pests when applied aerially or via an irrigation system. It is critical that screenings of new compounds continue in order to develop replacement tactics for compounds lost, due to FQPA.

This work is a continuation of cooperative study between Washington, Oregon and Idaho due to the high degree of overlap between potato insect problems in these two states.

(2) & (3) Research Impacts and Outcomes

In Oregon, seven trials were conducted to evaluate mechanisms for suppression of (a) potato leafroll virus (PLRV) and aphid (3 of 7 trials), (b) Colorado potato beetle (CPB) (1/7), (c) wireworms (2/7) and (d) two-spotted spider mite (1/7). In the three aphid-virus trials, a total of 60 treatments were evaluated: in the CPB trial 24 treatments were evaluated; in the two wireworm trials a total of 72 treatments were evaluated; and in the mite trial 12 treatments were evaluated.

Results from these, and preceding trials, have contributed to the registration of Admire, Provado, Gaucho, Genesis, Baythroid, Success and Fulfill insecticides, and NewLeaf and NewLeaf Plus GMO potato clones. Results from these trials encouraged DuPont to register a new formulation of Vydate (CLV) that is more economical to use. Results from these trials are being used in current applications for registration of Pirimor, Aztec, Actara, Adage and Platinum. Data from these trials have been or are being used to defend continued registration of the insecticides Furadan, Imidan, Mocap (both granule and liquid), Monitor, and Temik.

Significant discoveries from 2000 research include:

Many commonly used and relatively inexpensive insecticides can be substituted for pyrethroid insecticides to control Colorado potato beetle in early season potato without creating green peach aphid vectored potato leafroll virus problems in full season potato.

Fall fumigation with Telone II provided effective control of wireworm in potato. Insecticides when combined with Telone II provided little added benefit. Metam-sodium provided less benefit in combination with Telone II in controlling wireworm when applied in the fall as compared to spring application.

Temik was shown to be more effective when applied in-furrow above the seed piece rather than in the furrow.

Temik, when applied at planting time, was demonstrated to lower two-spotted spider mite populations for a period exceeding 110 days. It suppressed mite population longer than it did for aphid.

Vydate CLV applied water-run proved to be very effective for control of aphid. When applied to control two-spotted spider mites, which had reached a population of 20 mites per leaf, it was the only product to reduce population.

Both cooperators conduct pesticide evaluations annually that are totally supported by industry. Where appropriate and acceptable to the contractors, results of these trials are reported to the potato commissions.

(4) Integrated Research

Collaboration of research is with scientists at Washington State University in Pasco, Oregon State University's Umatilla Extension Service, Department of Environmental and Molecular Toxicology, Department of Crop and Soil Science and the USDA-Agricultural Research Service in Prosser. The

research leaders will also collaborate with potato entomologists in other states, particularly Idaho. Industry cooperators include those from Wilbur-Ellis Company, Bayer Agricultural Division, Dow AgroSciences, FMC Corporation, Aventa, DuPont Agricultural Products, Eagle Ranch, Gustafson and Syngenta.

Malheur Experiment Station

Weed Control of Irrigated Crops and Rangeland

(1) Research Overview

Current research activities include evaluation of potential herbicides for use in minor crops, use of herbicides in combination with seeding desirable forage species to control noxious weeds and restore rangeland, and evaluation of new technology for management of difficult to control weeds. When possible, efforts also focus on providing a greater understanding of the biology of weed species in efforts to identify more effective management strategies.

(2) Research Impacts

Producers and land managers benefit from this work primarily through registration of additional herbicides for use in weed management programs and through locally adapted information on effective weed control strategies. Crop protection companies benefit from better understanding the benefits and uses of their products for crops and pests common to this area. Research in the past year has identified candidate herbicides that would be useful for alfalfa seed, onion, potato, and mint growers as well as herbicides with potential for use in rangeland restoration.

(3) Research Outcomes

Previous research has resulted in wide adaptation in the Eastern Oregon of "micro-rate" herbicide applications in sugar beets, a label for imazamox for use in alfalfa seed, support of registrations of metolachlor for control of yellow nutsedge in onions, and clethodim for control of grasses in forage alfalfa, seed alfalfa, and clover seed. Efforts have also supported a pending registration of dimethenamid-p for use on onions, potatoes, and sugar beets. In efforts to leverage the impact of this weed research program, cooperative efforts are being established or are ongoing with researchers within Oregon State University and with other universities throughout the Pacific Northwest and Western states as well as researchers in private industry.

USDA Goal 2 - To ensure an adequate food and fiber supply and food safety through improved science based detection, surveillance, prevention, and education.

OSU Program 4: Food Safety and Quality

Food Safety:

Animal Sciences

Although not identified in the POW as an Animal Sciences Department area, research in animal sciences is addressing enhanced composition in meat products and enhanced nutrient composition in eggs.

Home Economics

Prediction and Evaluation of Quality of Fruits and Vegetables

(1) & (2) Research Overview and Impacts

A preliminary study of 13 different varieties (Jonagold, Jonathan, lola Red, Spartan, Mutsu, Golden Delicious, Red Delicious, Gala, Empire, Cortland, Granny Smith, Winter Banana, Melrose) from a local apple orchard indicated weight, diameter, moisture, and color determination showed considerable variation. Data showed ranges from 136.6g for Jonathan to 254.6g for Mutsu variety with diameters 22.3 cm (Spartan) to 26.1 cm (Mutsu). The moisture content range was 70.7% in Red Delicious to 84.5% in Empires. Greater variability was determined in color (Hunter L, a, and b) values. Variation within each characteristic for each apple variety has facilitated further planning. Instead of using slices, total moisture will be determined on a quarter apple that has been frozen in liquid nitrogen and then powdered. Texture analysis using the texture analyzer will have all data backed-up. Color will be determined at four coordinates. The study used random selection of apples from the bin. Consideration of selection process will be further evaluated. This was a useful preliminary investigation into constraints inherent within the study investigating the interrelationships of physical and sensory evaluation of apple quality.

(3) Research Outcomes

The study of handling, transportation and home storage and use practices of purchased broccoli has been initiated and data is currently being collected. This study should assist grocery stores and supermarkets in practices they use for the home consumer.

Eldredge, E.P., Z.A. Holmes, A.R. Mosley, C.C. Shock, and T.D. Stieber. 1996. Effects of transitory water stress on potato tuber stem-end reducing sugar and fry color. *American Potato Journal* 73 (Nov.-December): 1.

Holmes, Z.A. 1996. Selected Characteristics of Thirteen Apple Varieties. (<http://www.orst.edu/food-resource/zah/apple.html>).

Holmes, Z.A. 1996. Production Practices and Characteristics of Frozen, Microwave-Cooked Broccoli. (http://www.orst.edu/food-resource/zah/broc_paper.html).

Meyer, H.H., A. Abdulkhalig, J.M. Thompson, Z.A. Holmes, N.E. Forsberg, and S.L. Davis. 1995. Callipyge gene effects on lamb carcass traits, muscle weights, and meat characteristics. *Proceedings, Western Section, American Society of Animal Science* 46:.

(4) Integrated Research

Environmental and Molecular Toxicology

Food Safety and Environmental Stewardship Program

(1) Research Overview

The Food Safety and Environmental Stewardship (FSES) Program at OSU is a research program committed to providing the highest quality analytical laboratory research support for: food quality assurance, environmental integrity preservation, enhancement of agricultural production, and recognition and dissemination of new knowledge. The FSES program is involved in the following types of research: environmental forensic chemistry, pesticide re-registration, extension efforts, communication, GLP facility, scholarly projects, and "Ready Response".

An advisory council was created 4/2000. The Advisory Council interacts with the FSES Program in the following ways: identifies and evaluates existing and emerging food safety and environmental stewardship issues in Oregon and the Northwest; works with the program to identify/recognize needs (research problems, education/technology transfer, service) that are relevant and valued by our constituents; works with the program in prioritization of programs which are relevant to our constituents; works with the program in promotion of the program at the college, university, state and regional levels (assist to increase visibility, relevance and importance of the program).

(2) & (3) Research Impacts and Outcomes

The accomplishments since 4/6/00 are: Creation of GLP Program, Re-Instatement of IR-4 eligibility, FSES program communication, FSES program research, Scholarly accomplishments, instituted GLPs, developed SOP manual, QAPP, and. SMM manuals.

GLP On-site Facility Audit, Coordination, FSES Analytical Laboratory, April 10-13, 2000. Re-Instatement of IR-4 eligibility. Facility Audit, conducted by IR-4 Western Region, Coordinated FSES Laboratory, Sept. 26-27, 2000.

FSES program research-Eastern Oregon: Chemical Bioavailability-SPMD The Virtual Fish. Semi-permeable membrane devices (SPMD) used in a field study for pesticides, demonstrated other sources of OC pesticides (forest, urban, agriculture). A report was sent to Malheur County Extension and requested/sent to: Malheur County (M.C.) Commissioners, M.C. Sanitation, M.C. SWCD and Oregon Fish and Game District Office, Ontario

This lead to the development of presentations, grants and publication.

Johnson, E & Anderson, K.A. "Bioavailable Organochlorine Pesticides in Water and Sediments in a Semi-Arid Region of Eastern Oregon" accepted 4/2001. Presentations at the following:

Johnson, E. & Anderson, K. "Bioavailable Organochlorine Pesticides in Waters and Sediments in a Semi-Arid Region of Eastern Oregon, USA" Amer. Chem. Soc. 221st annual mtg, April, 2001, San Diego.

Anderson, K. & Johnson, E. "Use of Semipermeable Membrane Devices to Determine Bioavailable Organochlorine Pesticide Residues in the Malheur Oregon Watershed" PITTCON '01 Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, March, 2001 New Orleans, LA. Ontario Pesticide Workshop, 2000.

FSES program research-Portland Harbor investigations into human health risks associated with the consumption of fish from the Willamette River superfund sites –PCB, Organochlorine Pesticides, and Mercury. The Oregonian, 4-day feature series: "River of Risk" 1) The Willamette's Poisoned Heritage, 2) Fishing and Health, 3) Trail of Toxics, and 4) Past to Future, all 4 days cover story (page 1) Dec. 17th, 18th, 19th, & 20th, 2000.

(4) Integrated Research

FSES program research-Biochemical markers for sub-lethal herbicides, analytical method for determination of Shikimic Acid, which is proportional to glyphosate application rates. A collaboration (Kennewick, WA) field study on hard red wheat. The technique was transferred to private sector, and lead to other collaborations. Another field study w/ sulfonylureas (ALS inhibitor herbicides) on potatoes looking for 2 amino butyric acid was initiated. Communication of the results was by:

Anderson, K., Loper, B. & Cobb, W. "Biological marker compounds for glyphosate and sulfonylureas applications are proportional in plant tissue field trials" Amer. Chem. Soc. 221st annual mtg, April, 2001, San Diego.

William, T. Cobb, Bob R. Loper, and Kim A. Anderson, "The Use of Metabolic Markers as an Indicator of Susceptible Plant Exposure of Certain Herbicides" W. Soc. Weed Science annual Mtg, Mar. 2001.

Loper, B., Cobb, W. & Anderson, K.A. "Glyphosate Application Rates Proportional to Shikimic Acid in Hard Red Wheat Plant Tissue" XII Annual California Pesticide Residue Workshop, Mar, 2000, Yosemite, CA.

Loper, B., Cobb, W. & Anderson, K.A. "Glyphosate Application Rates Proportional to Shikimic Acid in Hard Red Wheat Plant Tissue" PITTCON '00 Conference on Analytical Chemistry and Applied Spectroscopy, March 12-17, 2000 New Orleans, LA.. Anderson,

K.A., Cobb, W.T. & Loper, B.R., "Analytical Method for Determination of Shikimic Acid: Shikimic Acid Proportional to Glyphosate Application Rates" in press, J. Com. Soil Science and Plant Analysis, vol. 32 (2001), 17&18.

Mid-Columbia Agricultural Research and Extension Center

(1) Research Overview

Major research objectives are to lengthen storage life and maintain dessert quality of pome fruit. The current approach is to balance the applied research with the basic one. The first area of research is to identify some possible biochemicals in fruit during growth and development that can be used as reliable indices for harvest maturity. The second area of research concerns the regulatory enzymes and intermediates in metabolic pathways of fruit that may regulate the storage life, fruit quality, and storage disorders. The third area is to study non-chemical control of storage disorders and decays. Current research is focused on: (a) Lengthening storage life of winter pears by step-wise low oxygen storage; (b) Non-chemical control of superficial scald disorder on 'd'Anjou' pears by ultra-low oxygen storage; (c) Pre-conditioning winter pears, especially 'd'Anjou', for early marketing with ethylene; and (d) Study the basic mechanisms of physiological disorders and fruit ripening.

(2) & (3) Research Impacts and Outcomes

The major findings of my research career are as follows:

The storage life and quality of winter pears and apple fruit can be lengthened successfully by low oxygen storage. Currently the technology of low oxygen storage has been routinely applied by the fruit industry in the Pacific Northwest.

The changes in extractable juice and water-soluble pectins in pear fruit after storage can be used as a predictive tool for storage life and fruit quality.

A split application of ethoxyquin to control superficial scald of 'd'Anjou' pears. This method provides the fruit industry an effective control of 'd'Anjou' scald with a reduced ethoxyquin concentration and without any phytotoxicity to the fruit.

Ripening capacity of "under-chilled" 'd'Anjou' pears can be induced by ethylene preconditioning treatment for early marketing. 'D'Anjou' pears are incapable of ripening normally within 2 months of cold storage after commercial harvest. By preconditioning "under-chilled" fruit with 100 ppm ethylene for 2 to 3 days at 20 C, fruit remained firm and suitable for further shipment and distribution to the retail markets.

Preconditioned fruit are capable of ripening with good dessert qualities in the retail markets during early marketing season.

Pre-storage treatment of 600 ppb MCP to 'Bartlett' and 'd'Anjou' pears effectively inhibits the normal ripening capacity after a prolonged cold storage and thus extend the storage life. Further research is proposed to investigate the method of inducing the normal ripening capacity of MCP-treated 'Bartlett' and 'd'Anjou' pears after a prolonged cold storage.

Only pre-storage treatment of MCP or low oxygen storage of 'd'Anjou' pears effectively controls superficial scald disorder. 'D'Anjou' pears harvested at optimum maturity can be loaded in a CA room without any pre-storage treatment of ethoxyquin (a scald inhibitor) and stored at 30F with a CA regime of 0.8% oxygen plus <0.1% carbon dioxide for 90 to 120 days. When 'd'Anjou' fruits have been returned to air storage at 30F, they can be packed and marketed within 60 days with no treatment of scald inhibitor. Low-oxygen stored 'd'Anjou' pears will ripen with excellent dessert quality in the retail markets without developing any undesirable scald disorder.

The activities of pyruvate decarboxylase (PDC) can be used as a biochemical marker for early detection of skin black speck (SBS) and pithy brown core (PBC) disorders of 'd'Anjou' pears stored in stressful CA conditions.

(4) Integrated Research

USDA Goal 3 - Through research and education on nutrition and development of more nutritious foods, enable people to make health-promoting choices.

OSU Program 5: Human Health and Nutrition

Nutrition and Health:

Home Economics

Mineral Element Bio-Availability of Importance to Human Nutrition

(1) Research Overview

I have an approved 5-year plan that runs from October 1999 to September 2004. This research is examining mineral element bio-availability related to human nutritional status. Minerals investigated in various research efforts include fluoride, zinc and copper containing enzyme superoxide dismutase.

(2) & (3) Research Impacts and Outcomes

Two studies have been completed. In one study (project C in the approved plan), antioxidant status was assessed in marathon runners. The criterion was the zinc and copper-containing enzyme superoxide dismutase. Additional measures were collected by other investigators.

A second study was completed (project B in the approved plan). The potential risk of dental fluorosis in infants and young children was assessed by measuring fluoride content of foods that contained mechanically separated chicken (infant food, finger foods, canned meats, luncheon meats). The graduate student working on the fluoride research recently successfully defended a Master of Science thesis, and is finalizing the thesis for the OSU Graduate School. A manuscript from this thesis is in preparation to be submitted to the Journal of Agricultural and Food Chemistry (journal section on Composition of Foods).

The conduct of studies was interrupted by an approved sabbatical leave (March 2000 to September 2000). The sabbatical leave experience was extended through January 2001 by special agreement with the sponsor. The intent of the sabbatical was to learn molecular biology techniques connected with improving plans as a food supply for human nutrition. One of the techniques learned was the polymerase chain reaction (PCR). There are many potential uses for this technique related to human nutrition research such as in nutritional assessment. There is also potential for phytochemical research related to human health in this area.

(4) Integrated Research

OSU colleagues informing this work include faculty in Extension Family and Community Development; Crop and Soil Science.

Vitamin B-6 Bioavailability, Metabolism & Status: Relation to Human Health

(1) Research Overview

Vitamin B-6 plays a key role in maintaining immune function, neurologic function and overall well-being. The objective of this research was to evaluate factors that affect vitamin B-6 bioavailability, requirements and metabolism in adults.

(2) Research Impacts

The research to date has uniquely identified the role pyridoxine glucoside (a natural food component) plays in decreasing vitamin B-6 bioavailability. Human metabolic studies have shown that a low intake of vitamin B-6 (slightly less than the current recommended dietary requirement) adversely affects immune function tests in adult women. Collaborative research has shown that patients with AIDS and those taking drugs for TB have increased catabolism of vitamin B-6. The research on vitamin B-6 requirements has shown that extreme endurance exercise increases metabolism and need for this vitamin.

(3) Research Outcomes

These and previous studies from this research have been central in establishing the newly published Recommended Daily Intake (RDI) levels for vitamin B-6. (National Academy Press, Washington D.C., 2000).

(4) Integrated Research

The Principal Investigator has done cooperative research on vitamin B-6 with scientists at OSU in Exercise & Sports Science and nationally with researchers at Washington State University, Purdue University, University of Maryland and the University of Illinois at Chicago.

Food Science & Technology

Characterization and Improvement of Wine Yeasts

(1) Research Overview

Activity in calendar year 2000 involved continuing studies on sulfite toxicity and arginine metabolism in yeast, and yeast biofilm formation. A previous study concerning the antimutagenicity of yogurt has been completed.

A. Sulfite toxicity

Sulfites are valued for their antioxidant and antimicrobial properties and enjoy widespread use as preservatives in foods, beverages, and pharmaceuticals. Wine strains of the yeast *Saccharomyces cerevisiae* have been bred and valued over centuries for resistance to the sulfite winemakers use during winemaking.

We are interested in learning the basis for sulfite resistance in yeast, and initiated a molecular genetic analysis of sulfite metabolism a number of years ago. Our results suggest that sulfite resistance in *S. cerevisiae* is due to the presence of a protein that acts as a "sulfite pump", that keeps sulfite levels in cells low enough to prevent toxicity.

B. Arginine metabolism

We have been attempting through genetic means to alter the way in which yeast metabolizes arginine during winemaking so that its value as a nitrogen source will be maximized. Arginine is normally a major grape constituent, and its improved use by wine yeasts may reduce the incidence of incomplete wine fermentations.

C. Biofilm formation

Sherry production involves two yeast-mediated transformations of grape juice. The first is conversion of grape sugar into ethanol (common to all wines), and the second is oxidation of a small amount of the ethanol into acetaldehyde by a film of yeast that grows on the wine surface, a property unique to sherry yeasts. The focus of our work has been to understand the biology of biofilm formation.

(2) Research Impacts

Our main contribution was new knowledge, which at this stage is of most benefit to the scientific community.

(3) Research Outcomes

One practical benefit was the development of a fermentation-based method to reduce the cost of disposing of cherry brine, a byproduct of producing processed cherries, which is of potential value to the Oregon cherry processing industry.

(4) Integrated Research

Collaborators:

Dept of Biochem, Dept of Microbiology, OSU
UMDNJ-New Jersey Medical School
University of Sassari, Italy
University of Dijon, France

Publications

Park, H. and Bakalinsky, A.T. (2000) SSU1 mediates sulfite efflux in *S. cerevisiae*. *Yeast* 16:881-888.

Park, H., Lopez, N.I., and Bakalinsky, A.T. (1999) Use of sulfite resistance in *S. cerevisiae* as a dominant selectable marker. *Curr. Genet.* 36:339-344.

Avram, D., Leid, M., and Bakalinsky, A.T. 1999. Fzf1p of *S. cerevisiae* is a positive regulator of SSU1 transcription and its first zinc finger region is required for DNA binding. *Yeast* 15:473-480.

Wollowski, I., Ji, S.-T., Bakalinsky, A.T., Neudecker, C., and Pool-Zobel, B.L. 1999. Bacteria used for the production of yogurt inactivate carcinogens and prevent DNA damage in the colon of rats. *J. Nutr.* 129:77-82.

Nadathur, S.R., Zhou, L., Lowry, R.R., and Bakalinsky, A.T. 1998. Effects of hydrolysis of milk glycerides on the antimutagenicity of a hexane extract of milk. *J. Dairy Sci.* 81:664-671.

Application of Protein-Based Antimicrobials in Food and Beverage Production

(1) Research Overview

We are investigating the use of protein-based antimicrobials in protecting foods and beverages against pathogenic and spoilage microorganisms. These antimicrobials provide an alternative to chemical preservatives such as sulfites, nitrates and sorbate that have gone out of favor with consumers due to possible negative health effects.

(2) Research Impacts

A patent application has been filed in 23 different countries that addresses the use of the antimicrobial lysozyme in brewing operations and brewery products. Food processors are evaluating the use of protein-based antimicrobials in particular the peptide nisin as a substitute for conventional preservatives.

(3) Research Outcomes

West coast wine makers are continuing to adopt the use of lysozyme as an antimicrobial against spoilage bacteria that can occur in wine. The Bureau of Alcohol, Tobacco and Firearms is evaluating lysozyme for inclusion into the list of approved wine additives

(4) Integrated Research

Dr. McGuire of Biological Engineering and Mark Daeschel of Food Science and Technology have had an active collaboration during the past 12 years. The current research has also included Dr. James Ayres from the College of Pharmacy as a collaborator.

Publications for 2000

Bani Jaber, A., J. McGuire, J.W. Ayres and M.A. Daeschel. 2000. Efficacy of the antimicrobial peptide nisin in emulsifying oil in water. *J. Food Sci.* 65:502-506

Lee, W.K., A.Bani-Jaber, J. McGuire, M.A. Daeschel and I. Jung. 2000. Interfacial tension kinetics of nisin and beta-Casein at an oil-water interface. *Korean J. of Chemical Engineering.* 17:179-183

Non-Thermal Processing of Foods

(1) Research Overview

Thermally processed foods in the United States and the world have had a remarkable safety record. For example, with an annual production of canned food and beverages approaching 50 billion cans, identifying cases of microbial food poisoning associated with this technology is difficult. On the other hand, refrigerated foods can deliver the quality desired but not the same safety. Commercial interest in refrigerated foods continues to expand rapidly in response to consumer demand for convenient and fresh-like products. New methods are needed to produce fresh-like products that are safe and stable. In recent years, my research on hydrostatic pressure processing (HPP) has confirmed it as a promising alternative. Large HPP research programs have been established in Japan, Europe and the U.S. with several products already commercialized in Japan and Europe. Commercial HPP products in the U.S. include oysters and guacamole and other salsas for the retail and food service industry.

(2) Research Impacts

We contributed to the development by Flow International Corp. (Kent, WA) of the technology used by AVOMEX (Dallas, TX) for avocado products. USDA funds were obtained for technology transfer workshop offered December 2000 in Chile with speakers from OSU, Mexico and one U.S. equipment manufacturer (High Pressure Research/UHDE).

(3) Research Outcomes

We have demonstrated the ability of HPP to modify cheese microstructure allowing control of curd syneresis in Cheddar cheese. An ongoing international study funded by Dairy Management Incorporated (DMI) is examining moderate hydrostatic pressure (MHP) treatments to use this finding to modify the shreddability of natural cheeses, including Cheddar and other natural cheeses produced by Tillamook County Creamery Assoc.

(4) Integrated Research

At OSU, we developed last year collaborations in environmental microbiology (Oceanography), instrumentation (Physics & Electrical Engineering) and use of animal models (Animal Science). We are expecting to obtain collaboration funds from one joint proposal and two letters of intent. International HPP collaboration with Mexico and Chile resulted in two funded grants. An additional international collaboration proposal is being prepared with the Polish Academy of Science and Washington State University.

Torres, J.A. and Savant, V.D. 2000. Recovery of low concentration proteins by chitosan-polyanion complexes: Application to wastewater treatments. Proceedings of the Eighth International Congress on Engineering and Food (ICEF8), Puebla, Mexico

G.V. de la Cruz, J.A. Torres, M.O. Martín-Polo. 2001. Temperature effect on the moisture sorption isotherms for methylcellulose and ethylcellulose films. Journal of Food Engineering. 48(1): 91.

Savant, V.D. & Torres, J.A. (2000). Chitosan based coagulating agents for treating cheese whey. Biotechnol. Prog. 16, 1091-1097.

Savant, V.D. & Torres, J.A. (2000). Fourier Transform Infrared (FTIR) analysis for treatment of surimi wash water with chitosan based coagulating agents. Annual meeting of the Inst. of Food Technologists, Dallas, TX.

Composition and Quality of Fruit and Vegetable Products

(1) Research Overview

This work addresses the impact of the chemical composition on product quality of fresh and processed fruit and vegetable products. In 2000, emphasis was on anthocyanin pigments and polyphenolics and their possible health benefits as measured by antioxidant activity. Commodities investigated included apples, cherries, blueberries, bilberries, blackberries, black currants, gooseberries, jostaberries, black raspberries, and potatoes. Utilization of juice processing wastes for natural colorants and nutraceuticals was also addressed, as was color quality of fruit juices and concentrates.

(2) Research Impacts

Year 2000 research provides information to nutritionists, plant breeders, and processors which should have a positive impact on human nutrition and health. An additional contribution is the development of better analytical methods for analyzing anthocyanin pigments and polyphenolics.

(3) Research Outcomes

There is intense interest in the possible health benefits of fruits and vegetables with respect to their dietary antioxidant levels. Through collaborative research with scientists at the Linus Pauling Institute, we have measured the antioxidant activities of a number of fruits and vegetables. Studies include the influence of cultivar difference, the distribution of antioxidants within fruits, the effects of post-harvest storage, frozen storage, and the impact of processing. This information is necessary to make nutritional estimates for the consumption of dietary antioxidants.

Cooperative research with plant breeders has shown that there is great potential for increasing the quantity of dietary anti-oxidants in fruits and vegetables. Experimental lines of both blueberries and potatoes are much higher in antioxidant activity, anthocyanin pigment and polyphenolic content than the major commercial varieties.

Analysis of seeds, pits and juice processing wastes has demonstrated that these materials are rich in anthocyanins and polyphenolics making them potential sources for natural colorants and nutraceuticals. We have identified sinapyl derivatives of glutathione as major compounds in pineapple. These novel compounds have never been identified before in nature, and they have both anti-browning activities and anti-oxidant levels comparable to vitamins C and E. We have received Notice of Allowance for awarding of a patent covering composition and application as anti browning and anti-oxidant preparations.

We have extensively investigated radishes and red-fleshed potatoes as potential sources for natural colorants. These materials have a desirable red hue and better stability than other anthocyanin pigment based colorants. This research has generated ten refereed journal articles, one book chapter and one patent "Natural colorant from potato extract". Patent No. US 6,180,154 B1, Jan. 30, 2001. We were the first to investigate radishes as a source for natural colorants. Both Japanese and Taiwanese firms are now commercially producing radish anthocyanin extract.

(4) Integrated Research

Collaborative Scientists:

Plant Breeders/Horticulturists: Chad Finn (USDA, NWCSFR, Corvallis, OR; Kim Hummer, USDA Germplasm Repository, Corvallis, OR; James Myers, Dept. Of Horticulture, OSU; Charles Brown, USDA Potato breeder, Prosser, WA); Paul Chen, Mid Columbia Experiment station; Anita Azarenko, Department of Horticulture, OSU.

Chemists / Biochemists: Balz Frei, Linus Pauling Institute, OSU; Richard Moyer, Biochemist, King College, Tennessee; Max Deinzer, Department of Chemistry, OSU; Victor Hsu, Dept of Biochemistry, OSU; Grete Skrede, MATFORSK (Norwegian Food Research Institute, As, Norway)

Internal & External Linkages:

Washington Apple Commission
Washington and Oregon Sweet Cherry Commissions
Northwest Cherry Briners
Oregon Blueberry Commission
Northwest Center for Small Fruit Research
USDA Germplasm Repository
USDA/ARS , Prosser, WA
Linus Pauling Institute (OSU)
Department of Chemistry, OSU
Department of Biochemistry, OSU
Department of Horticulture, OSU
Food Innovation Center, OSU
Mid-Columbia Experiment Station , OSU
Hermiston Experiment Station, OSU
Southern Oregon Experiment Station, OSU

Fruit Juice Quality Advisory Committee - Consortium of sixteen firms collectively supporting our research on fruit juice quality.

Publications

Dong, DONG, X., WROLSTAD, R.E., & SUGAR, D.. Extending shelf-life of fresh-cut pears. J. Food Sci. 65: 181-186.

SKREDE, G., WROLSTAD, R.E., & DURST. 2000. Changes in anthocyanins and polyphenolics during juice processing of highbush blueberries (*Vaccinium corymbosum* L.) J. Food Sci. 65: 357-364.

KARADENIZ, F., DURST, R.W. & WROLSTAD, R.E.2000. Polyphenolic composition of raisins. J. Agric. Food Chem. 48: 5343-5350.

RODRIGUEZ-SAONA, L.E., GIUSTI, M.M., DURST, R.W. & WROLSTAD, R.E. 2000. Development and process optimization of red radish concentrate extract as potential natural red colorant. Accepted for publication in J. Food Processing and Preservation.

PAZMINO-DURAN, E.A., GIUSTI, M.M., WROLSTAD, R.E. & GLORIA, M.B.A. 2000. Anthocyanins from banana bracts as potential food colorants. Accepted for publication in Food Chemistry.

WROLSTAD, R.E. 2000. Colorants, Chp. 14, pp 215-239, in Food Chemistry: Principles and Applications., G. L. Christen & J. S. Smith, (Ed.), Science Technology System (STS), West Sacramento, CA.

WROLSTAD, R.E.2000. "Anthocyanins", Chp.11, pp 237-252, In, Natural Food Colorants . F. J. Francis and G. J. Lauro (Ed.). Marcel Dekker, Inc., NY.

WROLSTAD, R.E., GIUSTI, M.M. & RODRIGUEZ-SAONA, L.E. 2000. "Anthocyanins from Radishes and Red-fleshed Potatoes", Chp. 5, pp 66-89, in Chemistry and Physiology of Food Colors. J. M. Ames and T. Hofmann (Ed.). ACS Symposium Series, American Chemical Society, Washington D.C. In press.

Environmental and Molecular Toxicology

National Pesticide Medical Monitoring Program

(1) Research Overview

In the year 2000, a total of 497 inquiries were received by the National Pesticide Medical Monitoring Program (NPMMP), involving pesticide concerns and human exposure incidents in 649 people. Inquiries came from 47 states, and included the general public, health care providers, state agency programs, and the public health community. The greatest number of inquiries came from pesticide use in the home. Household pesticide exposures are an important area of inquiry, as other national injury surveillance programs (such as the National Institute of Occupational Safety and Health Sentinel Event Notification System for Occupational Risks) for pesticides are limited in scope to occupational (workplace) exposures.

(2) Research Impacts:

Trends and sentinel event exposures are reported by the NPMMP to the EPA on a quarterly basis, and recommendations are provided regarding future research or regulatory needs. Toxicologists at the EPA review NPMMP data and recommendations in the pesticide risk assessment process.

(3) Research Outcomes:

The investigators of the NPMMP have recently conducted a longitudinal analysis of data collected over the past five years (1996-2000), to identify trends and define information needs regarding human pesticide exposure incidents. A preliminary analysis of these data has shown that unintentional household exposures to general use pesticides (pyrethroids and organophosphates) have accounted for the majority of exposure incidents reported to the NPMMP. These and additional findings have been submitted for peer-review and presentation at the upcoming North American Congress of Clinical Toxicology. In addition to providing useful information that will assist the investigators in meeting NPMMP objectives, it is anticipated that the dissemination of these findings will increase awareness of the program among an important target audience (the clinical toxicology community).

(4) Integrated Research:

NPMMP co-investigator (Sudakin) is on the volunteer clinical faculty of Oregon Health Sciences University, and actively participates in the research and educational efforts of the Oregon Poison Center.

USDA Goal 4 - Enhance the quality of the environment through better understanding of and building on agriculture and forestry's complex links with soil, water, air, and biotic resources.

OSU Program 6: Agriculture and Environmental Quality

Natural Resources and Ecosystem Management:

Fisheries and Wildlife

(1) Research Overview

Bullfrogs are an important invasive exotic organism in wetlands of the Willamette Valley. New research focuses on the validity to the generally accepted premise that bullfrogs take prey based almost entirely on availability, or whether they perhaps exhibit selectivity in their prey selection. We are examining bullfrog stomach contents and comparing prey frequency with simultaneous frequencies of those prey items available in the aquatic and nearshore habitats.

(2) & (3) Research Impacts and Outcomes

Outcomes from this research will be a better understanding of bullfrog feeding ecology and perhaps a better understanding of their effects on native biota. This understanding might well influence a review of how bullfrogs are considered by the state fish and wildlife agency. Currently bullfrogs are classified as a game fish and their harvest is subject to some restrictions.

(4) Integrated Research

(1) Research Overview

This research includes three primary research components: (1) comparative ecology of Blue and Ruffed Grouse in Southwestern Oregon; (2) reproductive characteristics and habitat relationships of Mountain Quail in Oregon; and (3) modeling of Sage Grouse/habitat relationships in Western States. The first research component focuses on habitat use by two sympatric species of grouse that co-occur to better understand the habitat relations of each species, the potential relations to human management of forests, and to add to the knowledge of how closely related species co-occur. This research has both practical (management) and theoretical elements. Results of this work will be of value to wildlife biologists and land managers with regard to forest management practices. Preliminary results focus on the importance of riparian zones for reproductive activities for both species and mature forest stands for Blue Grouse winter habitat. The second research component compares habitat use and preferences of Mountain Quail in two contrasting habitats: (semi-arid forests of the Willowa Mountains of northeastern Oregon and the temperate forests of the Southern Cascade Range in southwestern Oregon). The final component is devoted towards an understanding of reproductive periods of Sage Grouse and how reproductive success is influenced by habitat conditions. The thrust of the current research focuses on filling the gaps in our knowledge of Sage Grouse habitat relationships, particularly factors that influence survival of chicks during the first 72 hours of hatching. The ultimate goal of this work, however, is to

construct a unified model of the influences of habitat on Sage Grouse throughout all key aspects of reproduction (from pre-laying through post brood rearing).

(2) Research Impacts

Primary impact of this work will relate to forest management activities by the US Forest Service and Bureau of Land Management. Oregon Department of Fish and Wildlife will benefit from this work regarding management of the two species. Lastly, the comparative nature of this work hopefully will benefit the scientific community. Results of the second component are already being employed by the Oregon Department of Fish and Wildlife in regard to areas suitable for the reintroduction of this species. Although these birds are common to abundant in much of western Oregon, there is a petition being prepared for federal listing for populations in the semi-arid zones of Oregon, Washington, and Idaho. This work will add substantially to the biology of this poorly known bird, which can be used for setting management goals, hunting seasons, etc. Those who will benefit from the current sage grouse research are the same agencies or organizations that have used our work in management plans and recommendations. The Sage Grouse serves as an indicator of the status of sagebrush communities to many individuals or organizations dealing with sagebrush-steppe habitats.

(3) Research Outcomes

There have been several submissions of petitions to list Sage Grouse federally and the result of this work will certainly influence some of the decision-making processes and management practices over vast landscapes in the western United States. Groups in the environmental community, landowners, U.S. Fish and Wildlife Service, Bureau of Land Management, and numerous state agencies potentially will use this work.

(4) Integrated Research

This has been conducted with the assistance of numerous collaborators including USFWS, Oregon Department of Fish and Wildlife, Bureau of Land Management-Oregon, Bureau of Land Management-Nevada, Bureau of Land Management-California, Bighorns Unlimited of Nevada, The Chuker Foundation, Safari Club International-Idaho, Oregon Hunters Association, and National Rifle Association, Quail Unlimited, and the Ruffed Grouse Society.

(1) Research Overview

In order to reduce the impact of farm and ranch management on wildlife and to better integrate agricultural production and wildlife habitat management, studies are needed that assess wildlife response to agricultural practices at multiple scales. Since 1991, my research program at Oregon State University has emphasized wildlife and agriculture including pesticide effects and risk assessment, fragmentation of agricultural habitats, ecological effects of specific farming practices, and livestock grazing. The goal of this research to determine wildlife response to agricultural practices and management at multiple scales. Specific objectives are to determine: (1) wildlife responses to field- or pasture-scale management practices such as mowing, haying and pesticide applications; (2) wildlife responses to management practices at farm or ranch scales; and factors affecting wildlife distributions and abundance at landscape scales.

(2) Research Impacts

This research primarily impacts state and federal regulatory agencies, other scientists, and environmental groups by identifying risk to wildlife in agricultural ecosystems.

(3) Research Outcomes

One outcome of this research has been better state labels on agricultural pesticides, specifically rodenticides.

(4) Integrated Research

This research is conducted collaboratively with Oregon Department of Agriculture, U.S. Environmental Protection Agency, U.S. Bureau of Land Management, U.S. Geological Survey, and with other OSU departments including Crop and Soil Science, Environmental and Molecular Toxicology and Forest Science.

(1) Research Overview

Our research program on stream/riparian networks in their historic and basin contexts integrates a series of long-term research, field experiments, historical environmental database development, GIS analysis of geomorphic and riparian change, modeling, and evaluation of future scenarios of ecosystem change. The research has four major elements: 1) properties of river networks, 2) ecological role of disturbances in streams and rivers, 3) restoration of fish communities, and 4) landscape analysis of future conditions and ecological restoration. We work with regional stakeholders to explore the ecological implications of current practices and policies as well as possible outcomes from future changes.

(2) Research Impacts

Our research has influenced regional and national actions in natural resource management and environmental planning. The research on trajectories of past and future change in the Willamette River basin has been used as the scientific basis for the Willamette Restoration Initiative formed by Governor Kitzhaber and led by President Paul Risser. Our research was highlighted in a recent tabloid on future change that was sent to more than 500,000 households in the state's newspapers. Our research on riparian forests, floodplains, and fish assemblages was a central part of the State of the Environment Report for the State of Oregon that came out in September 2000. Oregon Department of Environmental Quality is using our spatial data as a framework for developing Total Maximum Daily Loads for pollutants in the Willamette River basin. These products directly benefit the citizens of Oregon and the Willamette basin, including decision makers, watershed councils, environmental groups, natural resource groups and the public.

Our riparian research is highlighted in a National Research Council book on Ecology and Management of Riparian Systems. Our research on nitrogen dynamics in streams was published in Science and has led to a subsequent proposal to examine nitrogen dynamics in agricultural and urban systems. These research products directly influence the international research community and natural resource managers.

One of our major accomplishments this last year was organizing and conducting an international conference on Wood in World Rivers. More than 450 people from 24 countries attended this 5-day conference. 29 invited papers, 54 contributed papers, and 36 posters were presented at the conference. The American Fisheries Society Press will be publishing the invited papers in a book in 2002.

(3) Research Outcomes

Our research serves as a foundation for development of conservation approaches for the Willamette River basin and the State of Oregon. Our spatial databases are being used by Oregon Department of Environmental Quality, Oregon Department of Agriculture, Oregon Department of Forestry, Oregon Department of Fish & Wildlife, Department of Gravel and Mining Industries, Division of State Lands. The U.S. Forest Service is using our research for landscape planning and development of alternative land use practices.

(4) Integrated Research

Our research program actively cooperates with faculty and students from the College of Agricultural Sciences, Forestry, Science, Oceanography, and Liberal Arts. We work closely with scientists from the

University of Oregon in our research on the Willamette River basin. We meet regularly with agency personnel from the Governor's office, Oregon watershed Enhancement Board, Oregon Department of Fish & Wildlife, Oregon Department of Environmental Quality, Oregon Department of Transportation, Oregon Department of Agriculture, Oregon Department of Forestry, Department of Gravel and Mining Industries, Division of State Lands, METRO, watershed councils, U.S. Forest Service, Bureau of Land Management.

(1) Research Overview

The focus is on accumulating population and genealogical data on 5 selected streams in Oregon. Additionally, observations on wintering grounds of birds marked on these breeding streams continue. Birds from Oregon streams appear to have distinct but disjunct wintering grounds (Protection Island, WA and west coast of Vancouver Island, BC). Sample sizes are too small to make definitive conclusions. Small populations of Harlequin ducks and sparse re-observation opportunities limit the rate of data accumulation.

(2) & (3) Research Impacts and Outcomes

Research impacts are highly speculative at this stage. Harlequins are uncommon breeding birds in Oregon and may be nearly extirpated from Coast Range drainages. Their small population size, unknown status, and use of small to medium mountain streams in spring and summer make them a species of concern.

(4) Integrated Research

The work is loosely coordinated with and benefits from cooperation with ODFW, U.S. Forest Service, U.S. Bureau of Land Management, Washington Department of Wildlife, provincial and federal research biologists in British Columbia, and academic researchers at Simon Fraser University in British Columbia.

(1) Research Overview

The objectives is to 1) determine the effects of introduced trout on native biota in high-elevation lakes in North Cascades National Park Service Complex (NOCA) in northern Washington, USA; 2) determine genetic variation in long-toed salamander populations and relate the variation to population abundance and fish presence in NOCA lakes; and 3) increase understanding of the effects of wildfire on amphibian diversity in high-elevation lotic ecosystem in the central Oregon cascades.

We have prepared a final report for objective 1 that is based on an analysis of data collected from 1989-1999 to assess the impacts of stocked trout on larval long-toed salamanders and crustacean zooplankton in NOCA. The report is currently undergoing peer-review. Tissue samples from larval salamander populations from 15 NOCA lakes are currently being analyzed to assess genetic diversity within and among populations. We have begun to analyze the amphibian data from 16 lakes in an area that was intensively burned by a wildfire in 1998 and 16 lakes in an adjacent area that was not burned. We will be assessing differences in species composition and abundance between the two areas.

(2) Research Impacts

The National Park Service, the US Forest Service, and state fish management agencies will benefit from this work. The National Park Service, the US Forest Service, and the US Geological Survey funded the research.

(3) Research Outcomes

The National Park Service will use the information provided by this research to develop a high lakes management plan for NOCA.

(4) Integrated Research

We have work cooperatively with scientists from the US Geological Survey, the US Forest Service, Genetic Information Systems, the Department of Fisheries and Wildlife (OSU), the Department of Forest Science (OSU), the Department of Botany (OSU), and managers from the National Park Service.

(1) Research Overview

This is a faunal study of fishes of the Northwest, especially of Oregon, and seeks to provide the primary research needed to understand the diversity of native fishes and the evolutionary processes that contributed to their current distributions. For a number of reasons, many freshwater fishes in Oregon are both similar in appearance and poorly studied. Many fish biologists in Oregon routinely ignore non-game species (sculpins, minnows, suckers) and most avoid (because of gear choice) or ignore (because of identification difficulty) the young stages of all fishes. We use the OSU Fish Collection as the primary resource supplemented by field research. The approach has been to carefully document morphological, genetic and ecological characters of fishes across their range and to search for zoogeographic patterns. The research contributes to making an "ecosystem approach" to environmental problems possible.

(2) Research Impacts

Ignorance of fish biodiversity poses two dangers. First, efforts to protect un-substantiated "forms" can prove counter-productive when those "forms" are shown to be wide-spread and not unique. A species thought to be "sensitive" and a candidate for federal protection, the Malheur mottled sculpin, has been shown to be more widespread and to naturally hybridize with another native sculpin. On the other hand, not protecting rare, sensitive forms because no one has bothered to study them increases the possibility that real biodiversity will disappear before we even know it existed. A species thought to be extinct, the Miller Lake lamprey, has been shown to be extant and to have a larger range than expected. Current work includes studies of native redband trout, redband shiner complex, largescale sucker complex, and tui chub complex.

Additional work focuses on Klamath Basin endangered suckers; recent reports have been utilized in developing the Biological Opinion on the operation of the Klamath Project (**Error! Hyperlink reference not valid.**).

(3) Research Outcomes

Critical reviews of the Biological Opinion and of the Klamath Water Users Plan have also been prepared.

(4) Integrated Research

We have work cooperatively with scientists from the US Geological Survey, U.S. Fish and Wildlife Service, Oregon Department of Fish and Wildlife, the Zoology Department (OSU), and managers from the U.S. Fish and Wildlife Service, National Refuge System.

(1) Research Overview

This work will contribute to a general understanding of wildlife population response to landscape structure at multiple spatial scales. I rely primarily on the black-tailed deer fawn to explore a more general model for demographic response of wildlife to habitat structure at multiple spatial scales. I use an approach that concurrently investigates variables associated with habitat selection and habitat use on both a micro and landscape scale as important predictors of wildlife demography.

(2) Research Impacts

This work will directly impact the way in which the State of Oregon manages deer populations west of the Cascade Mountains. Due to an apparent decline in deer populations, state wildlife managers need to better understand the impact of specific forest management practices on deer populations. State of Oregon wildlife biologists have identified knowledge of fawn ecology as a key missing link in understanding fluctuations in deer populations.

(3) Research Outcomes

Research is ongoing and will provide specific recommendations for managing the effects of forest habitat structure on deer demography and provide management alternatives for existing forested landscapes. To date, work supported has resulted in student recruitment, study planning, field data collection, and preliminary data analysis.

(4) Integrated Research

This research has resulted in direct collaboration between Oregon State University faculty in the College of Veterinary Medicine, the Department of Statistics, the Department of Animal Science, and the Department of Fisheries and Wildlife. In addition, the work has resulted in collaboration between Oregon State University, the Oregon Department of Fisheries and Wildlife, US Forest Service, Weyerhaeuser Company, and the Oregon Foundation for Blacktail Deer.

(1) Research Overview

From a scientific perspective the Principal Investigator's research is aimed at understanding how fish relate to their environment by developing theory concerning how environmental and genetic factors affect physiological systems and ultimate performance of the fish. The broad goal is to understand how the environment affects fish quality and hence fitness. One program is concerned with stress physiology and how the environment and genotype interact to describe realized phenotypic traits of importance to general health and development. Another program is directed at elucidating mechanisms involved in reproductive physiology to provide an understanding of how the final maturation process is controlled and to develop theory regarding maternal inheritance of endocrine factors of potential importance in regulating early development. The third programmatic goal is to learn how fish orient or respond to gradients of various environmental factors such as water flow, nutritional status, odorants, and temperature to explain orientation mechanisms such as juvenile migration patterns and imprinting of salmonids. These programs relate to the fourth, to provide an understanding of the genetic control of performance traits.

From a management perspective the research can be divided into program areas consisting of numerous programs. One program concerns overcoming problems associated with juvenile salmonids rearing and migrating in altered river systems. This work involves developing recommendations for managing flow, improving juvenile collection, passage and transport systems at Columbia and Snake river dams, and providing information on habitat needs for sensitive or ESA-listed "species" to enhance survivorship, reduce straying, and maintain genetic integrity. This program meshes with another, providing a genetic characterization of Northwestern salmonids and others. This information is vital to agencies making land use decisions at a very local level and for development of genetic guidelines and risk assessments at a larger level; this information has direct bearing on ESA decisions. The last program is directed at development of methods and technologies for better health management of fish in natural systems as well as hatcheries. This work includes optimizing general health of fish, including pathology and

toxicology; the research requires study of fish in rivers, estuarine systems and to a limited extent the ocean. This work also provides methods for optimizing rearing of captive broodstocks for listed species.

(2) Research Impacts

The following groups and agencies benefited for the work. The Oregon Department of Fish and Wildlife, the National Marine Fisheries Service, the U.S. Army Corps of Engineer, the Oregon Department of Environmental Quality, the U.S. Fish and Wildlife Service, and the U.S. Geological Survey.

(3) Research Outcomes

My group's discovery that birds such as Caspian terns may be a significant source of mortality for juvenile salmonids emigrating from the Columbia River system has lead to a management program for the birds. Other work has developed an accurate method for sexing sturgeon, a process that before necessitated Northwestern state biologists to perform surgery the field with limited accuracy.

(4) Integrated Research

Research is conducted cooperatively with co-principal investigators in (1) the OSU Department of Microbiology for work concerned with fish health and toxicology, (2) the National Marine Fisheries Service for work concerned with bycatch survivorship, (3) the Oregon and Washington Departments of Fish and Wildlife, the Oregon Department of Environmental Quality, and the Biological Resources Division, U.S.G.S. for sturgeon studies, (4) the University of Idaho and the Biological Resources Division, U.S.G.S, Cook Washington for Columbia River Dam and transportation issues, and (5) Japanese Institute of Agriculture, Nikko Branch, Nihon University, and Kitasato University, Japan, for studies concerned with aquaculture.

(1) Research Overview

This research includes three primary components: (1) role of the Tui chub, *Gila bicolor*, in the food web of East Lake, Central Oregon; (2) Ecology of Long-Toed Salamanders, *Ambystoma macrodactylum*; and (3) American shad: infection with the nematode *Anisakis simplex*. East Lake was a fishless caldera lake that today supports lucrative fisheries for desirable salmonids (Atlantic salmon, rainbow trout, brown trout, kokanee, brook trout). East Lake also supports dense populations of tui chub, considered a 'pest' species, and recent surveys have found high levels of mercury contaminants in the flesh of large salmonids in East Lake. This study examines the role the tui chub plays in the food web of East Lake. The tui chub functions as both a food competitor (with small kokanee and brook trout) for plankton, for all fish for macroinvertebrates, but serves as a food source for the larger trout and salmon in the lake. This may be the cause of the bioaccumulation of high levels of mercury observed in the larger, more piscivorous trout. Data on diets, as well as sizes, ages, and rates of growth of tui chubs and salmonids were collected during the Summer 2000. Anglers were surveyed to ascertain the quantities and types of fish eaten by humans.

Many of the amphibians native to the Pacific Northwest evolved in areas that were historically without fish. Aggressive fish stocking programs have expanded recreational opportunities for humans, but have also resulted in dramatic declines in populations of some amphibians, whose larvae are unable to survive predation by fish. This component addresses the impact of fish introductions on the genetic diversity of local populations as well as on the metapopulation dynamics of the long-toed salamander in high elevation lake systems. We have collected tissue samples, have constructed a DNA microsatellite library, and are currently screening samples for genetic diversity.

Members of the herring family are important fish hosts for the parasitic nematode *Anisakis simplex*. Native species of herring in the PNW are marine, but the introduced American shad (*Alosa sapidissima*) is anadromous. We examined carcasses of American shad for the presence of *Anisakis* to determine if this introduced species poses a risk for spreading a marine parasite into freshwater systems in Oregon.

(2) Research Impacts

In the first component surveys determined that many anglers eat fish from East Lake, despite posted warnings and advisories about the mercury. Human consumers may benefit from this study. For the second component National Park Service and Oregon Department of Fish and Wildlife may consider genetic impacts on local amphibians before introducing fish into naturally fishless lakes. In the final component, all shad collected from the Umpqua and Willamette Rivers were found to be heavily infected with Anisakis. This reveals potentially serious health risks for wildlife and human consumers.

(3) Research Outcomes

This work may help managers design strategies to keep mercury out of the food web and reduce risk to human and wildlife consumers in several lakes and reservoirs in Oregon. Outcomes of the second component help the National Parks Service develop management plans for high-elevation Cascade parks in the Pacific Northwest.

(4) Integrated Research

This work was conducted in collaboration with the USDA Forest Service, Oregon Department of Fish and Wildlife, U.S. National Park Service, U.S. Geological Survey, Seattle City Light, Genetic Identification Services and East Lake Resort.

(1) Research Overview

This long-term research has concentrated on erosion potentials, erosion prevention, streambank sloughing, and water quality as related to vegetation\soil complexity and land use management strategies. It is focused primarily in eastern Oregon on the semi-arid rangelands of the Mazama, High Desert, and John Day ecological provinces. The work began in 1975 and continues to provide Oregonians and others with scientifically based watershed relationships.

(2) Research Impacts

The impact of this work has been to quantify aspects of juniper woodland hydrology, grazing strategies in riparian zones, bacterial relationships associated with grazed watersheds, water temperature relationships with infiltration rates, and plant community relationships to hydrologic function of riparian systems.

(3) Research Outcomes

As a result of this effort managed grazing systems are in place throughout much of the West. The understanding between plant physiology, plant communities, erosion potentials, water quality and herbivory are much better understood. With this understanding, site specific prescriptions for land uses are possible. With ecological understand and careful management, sustainable (both environmentally and economically) systems are possible. In our global need to feed a growing population while at the same time providing a positive ecological environment, this research has provided guidelines and encouragement.

Dr. Buckhouse's research has resulted in well over a million dollars in research grants to OSU; in two hundred published titles; in thousands of professional talks\seminars and workshops; and in thousands of students who have been educated in his classes, field exercises, and workshops.

(4) Integrated Research

This research effort has resulted in a remarkable number of cooperative alliances. In the course of conducting, publishing, and presenting these studies many research partnerships have been formed. An incomplete list follows:

- *Colleagues within the Department of Rangeland Resources, OSU
- *Department of Fisheries and Wildlife, OSU
- *Department of Bioresources Engineering, OSU
- *Department of Environmental Sciences, OSU
- *Forest Engineering Department, OSU
- *Department of Animal Sciences, OSU
- *Department of Soil and Crop Sciences, OSU
- *The Oregon Plan for Salmon and Watershed Restoration (Independent Multidisciplinary Science Team)
- *Oregon Department of Agriculture
- *Oregon Governor's Watershed Improvement Board
- *Oregon Department of Water Resources
- *Oregon Department of Fish and Wildlife
- *Washington State University
- *University of Nevada, Reno
- *University of California, Davis
- *US Forest Service
- *US Bureau of Land Management
- *US National Riparian Team

Physiological Ecology of Native Species for Restoring Degraded Rangelands

(1) Research Overview

Research is being conducted to assess germination and cold temperature root growth as mechanisms to help explain why certain native rangeland plant species are able to establish on weed infested sites. Seeds of several native and one weed species were collected on July 13, 1999 from a research site near Madras, Oregon. A germination trial was conducted during winter term 2000 to assess viability of these collections. Seeds were germinated under dark conditions at 20°C for a 28-day period. Germination percentages were *Sitanion hystrix* -96%, *Stipa thurberiana* -36%, *Stipa comata* -3%, *Agropyron spicatum* -95%, *Dalea ornatum* -47%, and *Taeniatherum caput-medusae* -98%. Evaluations are currently underway to examine cold temperature (5°C) root growth of these species.

(2) & (3) Research Impacts and Outcomes

These evaluations of native species may promote cultivars for revegetation purposes and provide new crops for seed producers in central Oregon.

(4) Integrated Research

In addition, collaborative research efforts to develop restoration strategies for degraded rangelands have been initiated in conjunction with scientists, land managers and private citizens from Nevada, Utah and Idaho. Currently, several large-scale research initiatives are being prepared for submission to federal funding programs.

Recent Publications:

Doescher, P. S. 2001. Technical Note: Early Harvest of Squirreltail Seed. *J. Range Manage.* 54:197-199.

Meays, C.L. , A.S. Laliberte and P. S. Doescher. 2000. Defoliation response of bluebunch wheatgrass and crested wheatgrass: Why we cannot graze these two species in the same manner. *Rangelands* 22:16-18.

Goodwin, J. R., P. S. Doescher, L. E. Eddleman and D. B. Zobel. 1999. Persistence of Idaho fescue on degraded sagebrush steppe. *J. Range Manage.* 52: 187-198.

Ecology and Management of Western Juniper in Oregon.

(1) Research Overview

Year 2000 effort was devoted to measurement of long term changes in treated and untreated plots within degraded portions of the western juniper zone. Plots under study range in age from 9 to 18 years and have been re-measured periodically since inception. Treatments included cut-slash burn, cut-slash scatter, cut-leave and uncut. Pre-treatment broadcast seeding was included for some severely degraded areas. Focus has been primarily on successional changes in the cover and density of native grasses, forbs and shrubs and secondarily on establishment and maintenance of seeded grass species.

(2) Research Impacts

The diversity of native plant species (grasses, forbs and shrubs) has increased as to numbers, frequency and abundance over time on treated plots and conversely has continue a decline on untreated plots. Shrub components have gone from traces to a significant contribution on treated plots. Biomass of herbaceous material has begun to level off, however it remains at two to ten time that of the untreated plots. Plant cover is more homogeneous and bare ground is nearly one/half that of the untreated plots. Land managers concerned with vegetation diversity, productivity and watershed issues are impacted by this research.

(3) Research Outcomes

Procedures used in treatment of degraded western juniper lands as well as spatial-temporal expectations arising from the treatment have been modified and included in the recommendations used by extension personnel in eastern Oregon.

(4) Integrated Research

This is a cooperative study with the Central Oregon Agricultural Research Center and with the Crook and Jefferson County Extension Service Staff Chairs.

Ecology and Restoration of Oregon Foothill Rangelands

(1) Research Overview

We are studying the ecology of Oregon foothill rangelands as well as the impact of range weeds. We are developing techniques for the remote sensing of weedy species, field plots to identify sites that can be restored with perennial grasses, and a geographic information systems (GIS) approach that predicts areas at risk for weed invasion. We have also developed an Internet weed reporting and information system at <http://www.weedmapper.org> that covers the state of Oregon. Our work is also developing new methods for monitoring change in plant communities, measurement of vegetation in quadrants using digital imagery and GPS, and animal distribution and movement across the landscape. All these efforts

are focused toward improving our understanding of the ecology of rangelands and the changes induced by managerial systems.

(2) Research Impacts

We have created very detailed weed distribution maps of two test areas in southern Oregon: the Applegate Valley and the Bear Creek Valley. These maps indicate the invasion mechanisms operating for yellow starthistle and suggest where search and control efforts should be concentrated. We are also cooperating with local landowners and have established 20 research plots on their property. These plots will better define where restoration efforts should be concentrated.

(3) Research Outcomes

Our work is being used by the Oregon Extension Service to formulate recommendations for landowners as well as the USFS and USBLM. Detailed weed distribution maps have been created for parts of Jackson and Josephine counties Oregon, as well as the following research publications:

Clausnitzer, D.C., M.M. Borman, and D.E. Johnson. (1999). Competition between *Elymus elymoides* (squirreltail) and *Taeniatherum caput-medusae* (medusahead). *Weed Science*. 47(6):720-728.

Ganskopp, D., R. Cruz, and D.E. Johnson. (2000). Least-Effort Pathways: A GIS analysis of livestock trails in rugged terrain. *Applied Animal Behav. Sci.* 68(3):179-190.

Rudell, A.P., N.R. Harris, E. Coombs, and D.E. Johnson. 2000. Evaluation of the technological Methods to monitor the spread of the gorse spider mite in Oregon. p. 108-111. IN: Shenk, M. and Kogan, M. IPM in Oregon: Achievements and future directions. Special Report 1020. Oregon State University Extension Service, Corvallis, Oregon. 220pp.

Louhaichi, M., M.M. Borman, and D.E. Johnson. 2001. Spatially Located Platform and Aerial Photography for Documentation of Grazing Impacts on Wheat. *Geocarto International*. 16(1):

Laliberte, A.S., D.E. Johnson, N.R. Harris and G.M. Casady 2001. Time changed analysis using remote sensing and Geographic Information Systems (GIS) Technology. *J. Range Manage.* 53(2):A22-A50.

D.E. Johnson, N.R. Harris, M. Louhaichi, G.M. Casady, & M.M. Borman (2001) Mapping selected noxious weeds using remote sensing and geographic information systems. *Am. Chem. Soc. Proceed.*

Louhaichi, M., M.M. Borman, and D.E. Johnson (In Review). Production of high-resolution digital elevation models using DGPS and laser level technologies. *J. Range Manage.*

(4) Integrated Research

Cooperation has been with scientists from the Rogue River National Forest USFS, Plants Division of the Oregon Department of Agriculture, University of California/Davis and USDA Agricultural Research Service.

Ecology and Management of Foothill Rangelands

Analysis of Stream Canopy Quality and its Effect on the Heat Load of Streams

(1) Research Overview

The purpose of this study is to evaluate the amount and quality of canopy cover over Oregon streams to determine if the shade produced by different canopy structures (including species composition) differentially affects the ability of the canopy to protect the stream from the solar heat load.

(2) & (3) Research Impacts and Outcomes

This study will allow determination of the accuracy and consistency between current methods used to measure canopy cover. This is an ongoing study, with several dimensions incorporated. The first phase was conducted at five locations across the state representing several ecological provinces. The study will provide several benefits upon completion. It will allow us to determine the most accurate method to measure the amount of energy transmitted to stream surfaces under different levels of cover.

(4) Integrated Research

Many different agencies, universities, and private citizens are involved in data collection using various techniques therefore it is important to compare Hemispherical canopy photography which appears to be the state-of-the-art equipment with other data collection methods and to correlate these measurements to accurate measures of heat transmitted to the surface of streams. This work is being coordinated with the Department of Forestry and the EPA who are conducting similar studies, and with O.S.U. Extension Agents, Oregon Department of Fish and Wildlife biologists and private landowners who have provided support in the field.

The Effects of Four Different Cattle Riparian Grazing Treatments at Soap Creek Ranch near Corvallis, Oregon

(1) Research Overview

The purpose of this study is to evaluate the effectiveness of four grazing treatments on their ability to enhance the ecological health of the Soap Creek Watershed while providing some utilization of the riparian grasses for beef cattle production.

(2) & (3) Research Impacts and Outcomes

The grazing treatments have been designed to take into account the season of use, duration of grazing, intensity of forage utilization, natural climatic variability and overall cattle productivity. Each grazing treatment will be evaluated on how it (1) effects streambank stability at key water access points; (2) contributes to fecal coliform levels in the water; (3) impacts woody shrub cover and density; (4) utilizes riparian forage grasses; and (5) alters cattle grazing behavior. The first year of this two-year study has just been completed. The knowledge gained from this study will be incorporated into the Soap Creek Ranch Management plan and will provide guidance in developing an ecologically sustainable and economically sound grazing program.

(4) Integrated Research

Cooperators in the study include the Department of Animal Sciences and NRCS.

Agroforestry Systems for western Oregon

(1) Research Overview

Field trials investigating tree/livestock/pasture/environmental interactions of conifer and hardwood tree-based silvopastures have been underway since 1982. Research sites are located in the foothills of the Willamette Valley and in the Coastal Mountain Range, near Corvallis, Oregon. Major research thrusts have included water and light sharing between trees and pasture in time and space, use of livestock as a silvicultural tool, and , currently, use of agroforests as a carbon sink to reduce global warming.

(2) Research Impacts

Approximately one fourth of all forested land in the United States is grazed by livestock. The total area of grazed forest exceeds that of planted improved pasture. Silvopasture systems are being applied to these lands in order to increase profitability, reduce risk, and to increase environmental stability. Small farmers and non-industrial forest owners in western Canada, the Pacific Northwestern and Southern States of the U.S. are major adopters of silvopasture technology.

(3) Research Outcomes

Research conducted is providing the scientific underpinning for silvopasture extension efforts in Oregon and nationally. So far, research has resulted in publication of 28 journal articles, 4 book chapters, and 14 popular/extension articles, including two nationally distributed "Agroforestry Notes" from the USDA National Agroforestry Center. Two additional agroforestry notes are in preparation. Past silvicultural prescription grazing research provides the basis for wide scale use of sheep for vegetation control in British Columbia conifer forest.

(4) Integrated Research

Close links are maintained with the USDA National Agroforestry Center in Lincoln Nebraska, the University of Missouri Center for Agroforestry, agroforestry researchers at Louisiana State University, and Oregon State University College of Forestry. Current carbon sequestration research is cooperative with Dr. Syed Ismail of Ranga Agricultural University, Hyderabad, India. Past research has been cooperative with the USDA Forest Service, USDI National Park Service, and Oregon State University College of Forestry, and the Central Research Institute for Dryland Agriculture at Hyderabad, India.

Eastern Oregon Agricultural Research Center (Burns & Union)

(1) Research Overview

Research conducted involved the interactions of livestock and wild herbivores, herbivory impacts on plant communities and succession, and range livestock behavior. Research has focused on sustainable grazing systems in Forested Rangelands.

Specific areas of interest focus on management strategies to improve animal distribution in pastures that contain both upland and riparian habitat. Cattle grazing in spring can improve the production of bitterbrush (*Purshia tridentata*), and important wild ungulate fall and winter food by decreasing the physiological state of grasses making them less competitive. Regrowth of grasses in the same pastures has improved nutritive value over ungrazed grasses, also providing improved nutrition to wild ungulates.

(2) Research Impacts

Deer and elk can have negative impacts on plant community succession following disturbance. Some species of shrubs and forbs are eliminated from the communities, thereby reducing the heterogeneity of plant communities with potential impacts on biodiversity. Range livestock tend to use the same areas of a pasture year after year, while other areas are unused. Previous years' utilization was more important than distance to water, slope or aspect. Livestock and big game are impacting aspen communities in the Blue Mountains. The only current viable method of aspen rehabilitation is total exclusion of all herbivores.

Research to date has evaluated using offstream water/salting, and, timing of grazing to encourage optimal distribution of cattle through the pasture. In short, both offstream water/salt and early season of use was successful in decreasing proportion of time spent in riparian areas. In addition, both management strategies decreased use of the riparian area vegetation and increased use of upland vegetation. For all grazing studies, however, distributional patterns show a strong diel patterns with cattle distributing away from water sources during the late evening and night period, whereas, they move toward water sources in during the late morning to early afternoon period. Current research is focusing

on attributes of cattle (such as age, stage of production, breed type, and size) that may also influence resource/habitat selection and distribution patterns.

(3) Research Outcomes

Land managers are beginning to recognize the role of herbivory in shaping plant communities in the intermountain West. Forest Service and Bureau of Land Management managers are fencing aspen stands to exclude all herbivores as a cost effective means of rehabilitation.

The role and impact of beef cattle in forested rangelands is primarily a function of management of the livestock. The above research will be critical in helping land managers develop grazing systems that optimize animal behavior and production with the long-term sustainability of rangeland resources.

(4) Integrated Research

Cooperation with USDA-ARS; PNWRS-USDA,FS; BLM; Boise Cascade Corporation, Rock Mountain Elk Foundation, and University of Idaho. Additional funds provided by the EPA ACE program and USDA SARE program.

(1) Research Overview

This research is a long-term study on logging methods and herbivory effects in ponderosa pine and grand fir forest in the Blue Mountains.

(2) Research Impacts

Forage production for wild and domestic grazing animals is improved with logging. No deleterious effects to the watershed, increased run-off were incurred with the logging methods used.

(3) Research Outcomes

Long-term results on plant community changes are in progress. The primary limiting factors to forage production in ponderosa pine communities is root competition for moisture and nitrogen.

(4) Integrated Research

Botany and Plant Pathology

(1) Research Overview

We are investigating the molecular underpinnings of ammonia oxidation by bacteria. In the process of nitrification, ammonia (released naturally or applied as fertilizer) is converted to nitrate, which can then be leached from fields or transformed to gases, which can be lost to the atmosphere. The genes that code for critical enzymes in this process are under investigation, including their regulation by ammonia.

(2) Research Impacts

In the past year, we have focused on the genes coding for hydroxylamine oxidoreductase. Three copies are present in *Nitrosomonas europaea*, and we have systematically disrupted one or two copies to reveal that only one copy is required for growth, and any one copy will suffice.

(3) Research Outcomes

The research benefits all those interested in the environmental and agricultural consequences of N fertilizer use as a more complete understanding of this process emerges.

(4) Integrated Research

We are currently collaborating with scientists at Oregon State University, Utah State University, the University of Minnesota, the University of Louisville, Lawrence Livermore National Laboratory and Oak Ridge National Laboratory to sequence the entire genome of *N. europaea*, a well-studied ammonia-oxidizing bacterium.

Crop and Soil Science

(1) Research Overview

The efficacy of riparian buffer strips and poorly drained soils as natural attenuators of nitrates, phosphorus, and pesticides present in overland runoff and in shallow groundwater draining from agricultural fields in the Willamette Valley was investigated.

(2) & (3) Research Impacts and Outcomes

During periods of more intense rainfall, a significant fraction of the drainage to the local stream is in the form of overland flow, while under non-peak conditions water is transported laterally through the riparian buffer strip. The riparian buffer strip soils experience periods of deep reduction resulting in a significant lowering of the nitrate concentrations in runoff and shallow groundwater. The soluble concentrations of phosphorus are significantly higher in the riparian buffer strip suggesting that it may be a source rather than a sink for P. Ongoing work on the biogeochemistry of Fe and Mn in these ecosystems suggests these elements may play an important role in the degradation of herbicides and pesticides employed as part of the agricultural management program.

(4) Integrated Research

The work described above was performed in cooperation with scientists from the USDA National Forage and Seed Lab (Steve Griffiths and), the US EPA (Jim Wignigton), and the Environmental Molecular Science Laboratory, Richland WA.

(1) Research Overview

A series of experiments have been initiated to explore grape rootstock in acid soils.

(2) & (3) & (4) Research Impacts, Outcomes and Integrated Research

Evaluation of a in-field pot study will be made this year. The relationship between the grape vine nutrition (soil nutritional processes) and juice quality for processing into wine is largely unexplored. We (Baham) are currently working with a team of scientists, including Carmo Vasconcelos (Horticulture), Paul Schreiner (USDA - Small Fruits), and Andy Gallager (soil private consultant) to begin to explore these issues. Baham has organized a "soils investigation project" in conjunction with the Natural Resource Conservation Services which slated a two year field study beginning this summer. This work is designed to gather data on the 'red hill' soils of western Oregon used extensively in vineyard production. Our primary concern is soil management in vineyards including, liming, N, and soil water.

(1) Research Overview

My research is focused upon the role of soil microorganisms in processes that impact the fate of nitrogen and other agrochemicals in agro- and forest ecosystems. Specifically, my research centers around bacteria that are active in nitrification and N₂ fixation in soils, and those that carry out cooxidations of halogenated organic compounds and other pesticides.

(2) & (3) Research Impacts and Outcomes

The research impact of the past year is summarized in several publications in peer-reviewed journals, and in presentations and posters presented at meetings of my scientific peers (see portfolio for 2000).

(4) Integrated Research

Much of the research conducted by my group is collaborative and inter-disciplinary with OSU colleagues in the colleges of science, agricultural sciences, and engineering, and associated with the departments of microbiology, biological engineering, environmental engineering, botany and plant pathology, and environmental and molecular toxicology.

Central Analytical Laboratory

(1) Research Overview

The Central Analytical Laboratory (CAL) provides fee-based analytical services to OSU scientists and cooperating investigators in the agricultural, natural resource, and environmental sciences. The CAL also serves as an important resource for Oregon students and extension clientele seeking information and advice about plant, soil and water analysis.

(2) Research Impacts

The CAL is equipped and staffed to analyze for inorganic elements in soil extracts, plant tissues, water mixtures, and geologic substrates. Careful planning and entrepreneurial efforts have enabled the CAL to acquire a variety of state-of-the-art analytical instruments, focusing upon non-routine analyses and low-level elemental concentrations in plants soils and waters.

(3) Research Outcomes

Since its inception, the CAL has provided reliable analytical services to a wide range of clients in many disciplines. The CAL maintains a rigorous internal Quality Assurance/Quality Control program including standards for within-laboratory process control. To broaden quality assurance, the lab also participates in the North American Proficiency Testing (NAPT) program sponsored by the Soil Science Society of America. The CAL is also involved with a number of sample-split programs, mainly in water quality investigations. The laboratory is widely respected for the quality of its analytical services.

(4) Integrated Research

Analytical services are provided to OSU faculty and students and to non-OSU scientific collaborators. Public sector clientele include State and Federal agency scientists as well as AES scientists from a number of CAS departments and research centers. Private sector clientele include crop management consultants, environmental consultants and agricultural producers participating in foliage analysis programs. Nationally, the CAL is an active participant in the North American Proficiency Testing program. Regionally, the Program Leader is an active participant in WCC-103, Nutrient Management and Water Quality. The WCC-103 strives to protect water quality through improvements in nutrient management based upon soil testing and plant analysis.

(1) Research Overview

This research is designed to identify and develop nutrient management systems and tools to improve crop recovery of nitrogen and minimize leaching loss of nitrate-nitrogen from soil. Crops have included hops, corn silage, peppermint, wheat, and grass seed in the Willamette Valley.

(2) Research Impacts

Research has shown the potential to reduce N fertilizer rates by 50 to 150 lb N per acre on hops, corn silage and peppermint. While growers benefit from lower production cost, all of Oregon's citizens benefit from groundwater protection from nitrate-N contamination.

(3) Research Outcomes

Producers of corn silage, sweet corn, hops and peppermint have all reduced N fertilizer rates as a result of this research.

(4) Integrated Research

Research collaborators and supporters have included OSU Extension, USDA-NRCS, Oregon Department of Agriculture, Oregon Department of Environmental Quality. The PI has been an active contributor to WCC-103 "Nutrient Management and Water Quality" in developing research and educational programs throughout the western USA.

(1) Research Overview

Current studies are investigating effects of soil management on soil microbial community and soil quality. This work is being done in agricultural and forest soils. This is a statewide effort that compares various levels of ecosystem stresses of disturbance (tillage in agricultural systems and clear cutting and logging in forestry) and limitations of inputs in relation to soil microbial community structure. Work is also being initiated on tracking ¹³C during litter decomposition to begin addressing the role of the soil microbial community in sequestering C, which has implications for managing soils to offset climate change due to elevated CO₂ levels

(2) Research Impacts

Have developed simple methods for assessing soil quality to assist land managers to guide decisions towards improving soils for optimal plant growth. Earlier work concentrated on N in cover systems and has shown that cover crops can improve soil quality, affect soil microbial community diversity and soil structure, and significantly reduce nitrate leaching to groundwater. Have also shown that use of legume cover crops can reduce N fertilizer requirements on vegetable crops by 50 to 75 %.

(3) Research Outcomes

There are now practical soil lab and field based indicators for assessing soil quality. These are being used widely by extension staff in educational activities about soils. Basic research on soil enzymes and microbial community structure is widely recognized and cited in the scientific literature. Work on cover crops that included a leadership role in the development of a manual and a series of extension publications with cooperation from other OSU faculty has resulted from cover crops being nearly non-existent 10 years ago to being used on >50% of the row crop vegetable acreage (Dan McGrath, pers. commun.). Have given numerous extension presentations around the state on soil quality, soil biology, and cover crops.

(4) Integrated Research

We cooperate with Dr. Andy Moldenke of entomology where we combine my soil microbiology work with his work in soil fauna to understand how soil management affects different trophic levels in soils. Also, work with Dr. Dan McGrath linking his work on beneficial insect predators that spend part of their life cycle in soil with my work on use of organic inputs to manipulate soil the community. I serve on the Western Regional Committee For Sustainable Agriculture (WCC 67) and the NCR-57 Committee on Soil Organic Matter. Have a long-standing cooperation with Dr. Jeff Steiner, USDA-ARS, in relation to nonthermal management of grass residues to improve soil quality. Have cooperated extensively with the Soil Quality Institute, NRCS, in research and practical applications of soil quality indicators.

(1) Research Overview

The primary objective is to develop tools and methodologies for assessing soil quality and to gain a better understanding of carbon and nutrient (N, P, S) fluxes in soils as affected by cropping systems.

(2) & (3) Research Impacts and Outcomes

This research has lead to the development of a number of new techniques for assessing soil quality based on microbe biomass, enzyme and fatty acid analysis. These techniques have been published in journals and books and are used as tools around the nation and world. Work on nutrient flux in cropping systems has helped Oregon and Pacific Northwest growers make better decisions about use of cover crops and soil amendments to achieve soil quality changes in their soils.

(4) Integrated Research

This work involves cooperators from across the OSU campus, other Pacific Northwest land grant universities and the Natural Resources Conservation Service. The principal investigator has cooperative studies underway with scientist in Europe and Africa.

(1) Research Overview

This work is focused on understanding the cycling of nitrogen in soils. It is primarily fundamental research about the microorganisms that transform nitrogen in soil and how their activity is influenced by environmental factors and management activities. Most recently we have worked in three areas: (1) the diversity of Frankia, the nitrogen-fixing bacteria that form root nodules on several native plants, such as Alnus (alders), Ceanothus (e.g., snowbrush and deerbrush), and Purshia (bitterbrush); (2) examining how small-scale (micrometers to a few millimeters in size) heterogeneities, such as the rhizosphere, particulate organic matter, and different sizes of soil aggregates, influence nitrogen cycling; and (3) studying the linkage between the diversity of denitrifying bacteria and their activity along various environmental gradients (e.g., from agricultural fields to riparian zones, high-elevation grasslands to forests).

(2) Research Impacts

Our most significant product this past year was the showing that a new method (time-of-flight mass spectrometry) can be used to measure carbon and nitrogen assimilation by individual bacterial cells and fungal hyphae. This represents a new method for studying microbial activity in soils (and other, easier to work with habitats) at the scale of the microorganism itself. This finding will be initially of benefit to scientists.

(3) Research Outcomes

I am unaware of practical outcomes in terms of changing agronomic practices or economic benefits. One would hope the frontiers of science were budgeted a few micrometers, though.

(4) Integrated Research

Research efforts in the past two have involved cooperators from Sweden, DOE scientists at the EMSL lab in Richland, WA, scientists with the ARS and USFS units on campus, and OSU colleagues in Microbiology and Forest Science. Our isotope ratio mass spectrometer facility has provided analyses for researchers throughout OSU, the US, and even a few non-US users.

(1) Research Overview

This research seeks to 1) evaluate long-term effects of waste application on soil quality and crop productivity, 2) Develop/calibrate methods to predict waste nitrogen availability, and to 3) develop alternative uses for waste-derived products.

(2) Research Impacts

Studies conducted with municipal biosolids, yard debris composts, freshly ground yard debris determined appropriate application rates for economic and environmental perspectives.

(3) Research Outcomes

Studies conducted cooperatively with the CSREES W-170 group on biosolids N availability resulted in improved guidance for a national audience. The new guidance developed by the research differs from current USEPA guidance in a number of ways. First, N mineralization rates for fresh biosolids were substantially higher than present EPA guidance (last published in 1995). Second, estimated long-term N mineralization rates (through 3 yr after application) are based on a scientifically-defensible mechanistic computer model describing the decomposition process.

(4) Integrated Research

Oregon studies are integrated with other states via industry groups (e.g. Northwest Biosolids Management Association) and CSREES research and Extension projects. I participate in CSREES W-170, WCC-103 and SERA IEG-17 research and information sharing groups.

(1) Research Overview

This is a new soil physics effort focused on quantifying soil water movement through a range of scales from pore to landscape-level including characterization and modeling of saturated and unsaturated soil conditions. Research ranges from the most basic to very applied studies.

(2) & (3) Research Impacts and Outcomes

Basic research focuses on experimental and theoretical work to determine the limits of seepage into unsaturated fractures. Understanding of these limits is essential to the development of better models to predict how water contaminants may move through soils containing small or large fractures. Another more basic study is to determine if desert scorpions use differences in temperature gradients in their burrows (soil fractures) to determine the onset of night. Applied work is focused on developing

techniques to assess how field tile systems affect movement of soil surface contaminants into water systems during periods of heavy rain and to determine the cause of hydrophobicity in soils in some irrigated cropping systems and to determine if there are ways to deal with the excessive irrigation necessitated by hydrophobic soils and resultant environmental problems.

(4) Integrated Research

This research involves cooperators in other departments and colleges at OSU, at other universities across the United States and with US Geological Service and other federal agency scientists.

Agricultural and Resource Economics

Distribution of Agriculture's Environmental Performance in Oregon: Implications of Effective Policy Design

(1) Research Overview

The overall purpose was to assess the interaction between agriculture and the environment in Oregon. Agriculture both affects and is affected by changes in the environment. Agriculture also uses substantial amounts of land, water and other environmental inputs. As a result, farm-level decisions can have significant implications for environmental quality. Federal and state agricultural policies can also have unforeseen consequences on the behavior of the agricultural sector.

(2) & (3) Research Impacts and Outcomes

Work focused on three major areas; water use and policy, land use and policy and environmental change. In the area of water resources, studies were conducted on water use efficiency in the Klamath Basin of Oregon. Specifically, two studies (one MS thesis and one Ph.D dissertation) assessed the economic implications of alternative water allocations between agriculture and endangered species. These studies are the basis of on-going research conducted for the U.S Bureau of Reclamation to address the affects of current drought management problems in the Basin. Other studies addressed water quality problems in the Treasure valley area of eastern Oregon. A Ph.D dissertation examined the economic costs to irrigated agriculture of alternative water quality control policies.

Another area of focus was land use along the rural- urban fringe. Significant amounts of agricultural land are converted in the Willamette valley to other uses, despite restrictive land use zoning practices in Oregon. Two studies (both MS theses) addressed the economic value of open space in Willamette Valley communities. The first estimated the value of open space (wetlands and lakes) in the greater Portland metropolitan area. Results indicated substantial value from such open space to residents of the area. The second study addressed open space issues in and around Corvallis. Again, results indicated high economic value to the preservation of open space. Both studies have implications for state and local land use policies and suggest that the presence of open space, including agricultural lands, provide benefits to communities.

The third general topic area concerned the effects of environmental change on agriculture and agricultural resources. Climate change and climatic variability have the potential to alter agricultural productivity and profitability. A series of studies have addressed the economic costs of environmental change to agriculture in the Oregon and the US. While agricultural output is generally not affected substantially from climate change, the results also indicate a range of potentially negative effects, including increasing risk to agricultural producers and more agricultural runoff, erosion and wildlife habitat loss. These studies have been used in public policy discussions concerning the need to control certain "Greenhouse Gas" emissions and to design programs to assist agriculture in adapting to climate change.

(4) Integrated Research

(1) Research Overview

I have been involved in developing an integrated economic and social model for evaluating the impacts on ranchers and communities from changes in federal land grazing policies. Additionally, research has been conducted on the economic impacts of grazing management practices in upland and riparian areas.

(2) Research Impacts

The outcome of the research is intended to benefit public land ranchers, federal agencies, and rural communities as they seek improved policies and learn how to cope with both intended and unintended consequences of such policies. The information should also help ranchers in making management choices and federal agencies in designing improved grazing strategies.

(3) Research Outcomes

A survey of public land ranchers was conducted as part of the economic and social modeling effort. The results of this survey have been presented at various locations throughout the western U.S. The information has been useful to help delineate the discussion related to public land grazing policy impacts. This is the only part of the modeling effort that has been completed to date. The effects of the riparian grazing research are just beginning to be seen. We were able to show that some management practices and timing of those practices could lead to improved cattle weights, profits, and ecological conditions.

(4) Integrated Research

All of the research undertaken is integrated. The economic and social modeling effort involves scientists from 7 land grant universities as well as across disciplines. The riparian grazing effort involves scientists from 2 land grant universities and the USDA Forest Service PNW Research Station as well as from the disciplines of agricultural economics, animal sciences, rangeland resources and entomology.

(1) Research Overview

In the last few years, my research has focused on two major areas. One is the optimal design of conservation and environmental policy. In cooperation with Drs. Bill Boggess and Richard Adams, I have analyzed optimal allocation and targeting of conservation funds and the economic, environmental, and distributional implications of alternative targeting criteria. The second major area of my research is the interaction between land use and environmental quality. The research questions that I address in this area include how agricultural and environmental policy affects land use, and how the changes in land use may in turn affect water quality. I am also interested in issues of urbanization and farmland development. I analyzed the impact of county-level land use regulations on farmland development in five western states. I estimated the interaction between urbanization, land use regulations and public financial impacts. I also investigated the causes of fragmented, leapfrog development and the resulting economic, environmental and social consequences.

(2) & (3) Research Impacts and Outcomes

My research findings on the design and targeting of conservation programs have been communicated to government agencies through extension publications and direct meetings with them. For example, in cooperation with Drs. Bill Boggess and Richard Adams, we found that optimal allocation of conservation funds must consider the cumulative (threshold) effects of conservation efforts. We are pleased to see that a cumulative effect bonus has been included in Oregon's Conservation Reserve Enhancement Program. This bonus, which encourages landowners to make coordinated efforts for habitat enhancements, has been regarded by USDA as an innovative idea. My research has also resulted in a number of publications in high quality journals. These publications are contributions to knowledge in the area of environmental and resource economics.

(4) Integrated Research

I have cooperated with faculty members from other Departments of OSU and from other universities including Iowa State University, University of Minnesota, and University of Michigan.

Coastal Oregon Marine Experiment Station

Whale Behavior and Habitat Assessment from Satellite-Monitored Radio Tags

(1) Research Overview

The purpose of the program is to identify the distribution, movements, and critical habitats (feeding, breeding, calving, and migration areas) of endangered whale species, using satellite-monitored radio tags. Five species of large whales have successfully been tagged and tracked: 1) the North Atlantic right whale on its feeding grounds off the New England coast; 2) the migration routes of humpback whales from their Hawaiian breeding/calving grounds to feeding areas in British Columbia, Alaska, and Russia; 3) the migration routes of the North Pacific blue whale from feeding grounds off California to potential breeding/calving grounds in the eastern tropical Pacific; 4) gray whales from one of their breeding lagoons in Baja California north to San Francisco; and 5) bowhead whales in the Canadian Arctic in their fall migration route to Siberia.

With satellite imagery, oceanographic features (such as sea surface temperatures, currents, and productivity) of the areas that whales inhabit can be characterized, thereby improving understanding of what attracts whales to these sites. The program has also successfully documented the movements of stranded pilot whales, bottlenose dolphins, and an Atlantic white-sided dolphin after their release into the wild following rehabilitation

(2) Research Impacts

General: Research findings may directly affect the conservation and management of whale species. In identifying whale distribution and usage of the ocean, the program provides government agencies with information vital to the management of human activity that could jeopardize the recovery of endangered whale populations.

Specific: The Northern Right Whale Early Warning System group, which attempts to warn ships of right whale locations in order to prevent ship strikes (one of the greatest causes of mortality to this most endangered of the whales), benefited from our research last year by receiving regular updates from our office giving location data for tagged animals.

The Mexican government benefited from our fin and blue whale tagging efforts as it provided necessary information for the development of conservation plans.

(3) Research Outcomes

Significant changes in state or US: None. We can only provide information; taking action upon that information is the purview of state and federal governments.

(4) Integrated Research

Collaborative programs: NMFS, MMS, University of California at Santa Cruz, University of Alaska, Universidad Automidad de Baja California Sur.

Environmental Factors Influencing the Health of Fish and Shellfish in Oregon

(1) Research Overview

The pathology component focused primarily upon *Nadelspora canceri*, a recently discovered lethal microsporidian pathogen of the commercially important Dungeness crab, *Cancer magister*.

(2) Research Impacts

It was found that the parasite has maintained itself in the Yaquina Bay estuary at the 5 to 10% level for the past four years. No influence of temperature upon *N. canceri* infection level was detected although the fish infecting microsporidian *Glugea stephani* is strongly influenced by warm temperatures in the Yaquina estuary. Dungeness crabs become infected with *N. canceri* when they ingest infected muscle of crabs that have died. In the laboratory, juvenile crabs become infected by ingesting parasite spores directly out of the water.

(3) Research Outcomes

Although a lethal parasite in Cancer crabs, cooperative studies with the OSU Department of Zoology have shown that *N. canceri* will not infect the introduced green crab (*Carcinus maenas*) and so will not function as a biological control agent for this pest species.

(4) Integrated Research

Studies on pathogens of fish and shellfish have also included cooperative research with scientists from the National Marine Fisheries Service with particular regard to pathogens of salmonids.

Eastern Oregon Agricultural Research Center

History, Ecology, and Management of Sagebrush Steppe and Juniper woodlands.

(1) Research Overview

We evaluated the dynamics and impacts of fire (both wild and prescribed) and juniper encroachment on high desert plant and avian communities throughout eastern Oregon, northern California, and northern Nevada. Millions of hectares are threatened by wildfire in eastern Oregon every year. In addition, western juniper currently occupies 2 million hectares in Oregon, and is still rapidly expanding its distribution.

(2) Research Impacts

Juniper expansion and the lack of fire or too much fire across these semi-arid communities has dramatically changed plant and animal communities during the past 100 years across this semi-arid region.

(3) Research Outcomes

Results have been used to develop fire management plans and guidelines for restoration of plant communities and wildlife habitat.

(4) Research Integration

Southern Oregon Research and Extension Center

(1) Research Overview

Two separate aspects have been under study. First, we have been evaluating the impacts of redirecting the treated effluent from the regional sewage treatment plant from discharge into the Rogue River to more beneficial use as irrigation water for non-food crops. Implicit in that study is the effect on surface and groundwater quality as well as land productivity and nutrient recycling. The second aspect involved surveys of creek water quality parameters as affected by agricultural management of adjoining lands. This study seeks to determine to what degree certain agricultural management activities enhance or degrade stream water quality.

(2) Research Impacts

Depending on the final outcome of this multi-year study, both the City of Medford' sewage treatment ratepayers and nearby landowners could benefit from the first study. Ratepayers will benefit if the proposed effluent re-use project ends up costing less than additional levels of effluent treatment which may be required in the near future. Nearby landowners will benefit if they can receive low cost, nutrient rich water to use in irrigating non-food crops in areas where current productivity is limited by lack of irrigation water supplies and delivery systems.

(3) Research Outcomes

Results from this study, as well as others, is being used by various entities to better understand and productively grow hybrid poplar trees and other perennial fiber crops such as miscanthus. Results from the second study are also being used to evaluate whether limitations on agricultural activities due to supposed effects on stream water quality are warranted.

(4) Integrated Research

Both aspects are done in cooperation and consultation with engineers and scientists from local, state, and federal government agencies. Some of the fiber quality testing from this first study has been evaluated by the OSU Forest Products Lab.

Malheur Experiment Station

Development of Cropping Practices for Profitability and Minimum Environmental Impact

(1) & (2) & (3) & (4) Research Overview, Impacts, Outcomes and Integrated Research

1). Following the success of subsurface drip irrigation (SDI) on onions, SDI research was expanded in 2000 to alfalfa seed, poplar trees, and long term crop rotations. Subsurface drip irrigation has the potential to a). save water through reduced evaporation losses, b). reduce leaching and runoff losses of water, nutrients, and chemicals, c). reduce the needs for chemicals, and d). improve crop yield and quality for some crops.

2). The new anti-cancer drug "taxol" is produced in the bark of the Pacific yew. In 1996-1999, we successfully produced taxol and other taxanes sustainably and continuously through the hedge row planting of Hicksii yews that are ordinarily grown as ornamentals. In addition, we hypothesized increased taxane production through controlled levels of water stress, due to the similarity of the biochemical structure of taxol and other compounds produced by plants that are under stress. The outcome was published in HortScience in 1999.

An intriguing question remains of the biological role of yew taxane production. In 2000 we began looking for biological insecticides in Hicksii yews after being impressed by the absence of insects on these shrubs.

3) Onions were grown with subsurface drip irrigation in both 1997 and again in 1998 with different soil water potentials as irrigation criteria to determine the soil water potential at which optimum onion yield and quality occurs. These onions stored very well. Onions responded sensitively to small variations in soil water potential, with greater yield and quality response than many crops. The soil water potential requirements for onions with SDI were published in HortScience in 2000.

Can N fertilizer applications be radically reduced with SDI? Since deep leaching can be controlled, residual and applied N should be less subject to loss. Since there are now favorable price incentives for even larger onions, should the plant population of the onion crop be reduced from 125,000 - 140,000 plants/acre to 75,000 - 90,000 plants/acre? Since the irrigation requirements for onions are now well known, in 1999, 2000, and 2001 the emphasis of the onion SDI research has changed to determine the ideal plant population and N rate to maximize economic return.

4). Poplar tree research plots established in 1997 continued during 1998 and 1999. The water requirements of poplars and poplar response to soil water potential were determined. The results are in press in the Western Journal of Applied Forestry for 2002. The effects of cover crops on poplar establishment and growth also have been documented and are in press in the Western Journal of Applied Forestry for 2002.

Are micro-sprinklers as efficient in water use as drip irrigation for poplar growth? Does radical pruning to obtain clear saw logs without knots greatly reduce the rate of tree growth? In 2000 the MES poplar tree planting was converted to study the relative efficiency of micro sprinklers and drip irrigation systems. New sub plots in the poplar irrigation treatments examine the effects of pruning treatments on tree growth.

6). Variety evaluations were completed for sugar beets, soybeans, alfalfa, and onions in 2000. Trials look carefully at quality parameters for all four of these crops and onion storability after harvest. Soybean lines selected at MES, Ontario, OR were also tested at Madras, OR by Peter Sexton.

7). Efficient use of soil nitrate and the other available N sources listed above depend on irrigation being roughly in balance with crop water needs so that nitrate leaching is minimal or only moderate. We are working intensively to determine soil moisture criteria for irrigating poplar trees and onions. The goal is the right amount of water added at the right time. Dozens of growers have adopted the soil moisture criteria and soil moisture sensors for potatoes. Irrigation management has improved and is continuing to improve.

Several years ago we cooperated with the Bureau of Reclamation to build an AgriMet weather station to estimate daily crop consumptive water use. In 1997 we put linkages on the Malheur Experiment Station web page so that daily crop consumptive water use was readily available from our internet site. This service continued in 2000. The AgriMet output also provides MES with reliable baseline crop water use estimates complementary to crop irrigation research.

Soil Irrigation, and Fertility Management Effects on Potato Production and Nitrate Leaching.

(1) & (2) & (3) & (4) Research Overview, Impacts, Outcomes and Integrated Research

1. General.

Over the last 15 years this research has placed emphasis on the economic production of quality potatoes and potato products through refinement of irrigation, fertilization, and other management factors including variety selection. Results have been reported to growers and professional societies and have been published in annual reports and journal articles.

2. Potato late blight.

In the 1995 season, potato late blight became a serious threat to potato production in Malheur County and SW Idaho. Growers applied many products in a desperate attempt to stop the disease. Some of the spray options were unnecessarily costly and unneeded. Growers urgently needed predictive information and extension information during the last two seasons.

In 2000 we cooperated with other OSU faculty and UC Tulelake to predict late blight. New weather measuring equipment was purchased and services were expanded to Klamath Falls, Madras, and the Willamette Valley. The "in field" weather stations were established in cooperation with Lynn Jensen of OSU Extension and many other parties. Data was received by MES and the risk of late blight was calculated daily at MES. Weather data was used to estimate late blight risk using the "Blitecast" program.

We have made the data available during the potato growing seasons in 1996, 1997, 1998, and 1999 at the MES internet site, a 1-(800) number, and E-mail. The number of stations serviced was increased during 1998 and the number of parameters measured increased in 1999.

3). Innovations are needed to expand subsurface drip irrigation use to potatoes.

Potatoes develop irregular shape in response to variations in soil water. With drip irrigation it is possible to maintain better control of irrigation and nearly constant soil water. We propose to demonstrate how to improve potato grade through reduced stress on the potato plant. Less water would be applied at each irrigation and irrigations would occur at greater frequency. Normally potato irrigation at -30 kPa in heavy soil would result in swollen lenticels on the tuber and decomposition of the tuber, but with the offset of tape placement and use of additives in the water, the soil should remain aerated. New options will be explored on a small scale for growers' use.

A problem for growers is to shift costs from fertilizer and chemical inputs through more efficient irrigation. Positive precedents exist. Recent research at Malheur Experiment Station has successfully demonstrated the management practices reducing inputs and improving yields for drip irrigated onion production in Malheur County. Local growers have adopted these drip irrigation practices and commercial fields of drip irrigated onions are now being grown on 5,000 acres in the PNW.

Potatoes for processing also require high inputs of water and nitrogen to produce the crop and hold potential for input reduction coupled with market quality improvements.

SDI objectives for potatoes:

- a. Improve potato grade by more closely maintaining soil water potential through automated drip irrigation while avoiding swollen lenticels and water rot on tubers.
- b. Reduce tare dirt delivered with the potatoes to the processor.
- c. Reduce tuber bruising.
- d. Reduce the cost of drip irrigation by demonstrating the feasibility of irrigating two rows of potatoes with a single drip line in a single wide bed.
- d. Reduce nitrogen fertilizer and other chemical costs through carefully managed drip irrigation.

4. Variety evaluations.

We cooperate with the Oregon Statewide Potato Variety Development Program and the Regional program. Both the early and late regional trials were grown, plus the Oregon PYT and Oregon Statewide trial, early Aberdeen selections were grown in cooperation with Steve Love, and early and late variety trials were grown under drip irrigation. Potatoes are evaluated out of storage for internal quality, specific gravity and stem-end fry color.

In 2000, more early harvest varieties were tested at Ontario given local growers' economic opportunities.

Chemistry

(1) Research Overview

Mass spectrometry is used to address questions about the structures of biomolecules and to analyze for agriculturally, environmentally, and toxicologically relevant chemicals. The objectives are: to develop and implement mass spectrometric methods for the structural analysis of agricultural chemicals, environmental chemicals, and biological macromolecules; to provide mass spectrometric analysis support to other investigators through collaboration and services; to develop prototype mass spectrometry instrumentation for use in agricultural, environmental, and toxicological research.

Current core research includes development of: tandem time-of-flight mass spectrometry for biological molecules; gas chromatography/electron monochromator time-of flight for electron capture negative ion mass spectrometry for pesticides and other environmental chemicals; (iii) hydrogen-deuterium exchange methods to probe protein conformations, of interest in biotechnology and other areas.

Current collaborative research (and collaborating departments) includes: (i) mass spectrometric protocol for the analysis of UV-cross linked protein-nucleic acid complexes (Environmental and Molecular Toxicology Department); (ii) alkylation of neurofilament protein subunits (Oregon Health Sciences University); (iii) chemistry and biology of prenylflavonoids from hops (Environmental and Molecular Toxicology Department) and (iv) protein folding kinetics (Biochemistry Department). As examples, the latter two efforts are described in more detail below.

Flavonoids in Hops and Beer

Prenylflavonoid compounds found in hops and present in beer are potent antioxidants and effectively trap free radicals that cause cancer. This work is focused on the identification and characterization of these flavonoids. The flavonoids of hops include flavonol glycosides, condensed tannins, and prenylflavonoids. The first two flavonoid classes are located intracellularly, while the prenylflavonoids are secreted along with the bitter acids and essential oils by the lupulin glands of the inflorescences. In other words, the latter compounds are available in the hops used in brewing and 20-30% of them are transferred to the beer. The biological activities of some prenylflavonoids isolated include the inhibition of the growth of breast, ovarian and prostate cancer cells in a dose-dependent manner. The prenylflavonoids are not toxic to normal cells at concentrations that inhibit the growth of cancerous cells. In addition these compounds inhibit the cytochrome P450-mediated activation of procarcinogens while inducing the activity of the carcinogen-detoxifying enzyme, quinone reductase.. All known activities of these compounds in amounts present in beer appear to be non-harmful and may, in fact, have beneficial effects to the health of the consumer particularly through their action as antioxidants.

Protein Folding

The development of technology for large scale production of proteins in bacteria has increased the practical importance in understanding how proteins fold in vitro. This study is focused on understanding how proteins fold in vitro. Often, recombinant proteins are not generated in their native, soluble, active conformation but in insoluble, inactive aggregates known as inclusion bodies. After the inclusion bodies have been isolated, the protein aggregates must then be solubilized under denaturing conditions followed by refolding to the native state. Interest has arisen in trying to understand how proteins refold and in the development of technology to facilitate the refolding process.

In order for proteins to function in their prescribed roles, they have to fold up into specific conformations as they're being synthesized and the final conformation must not vary. Analysis of protein folding pathways poses a difficult problem requiring a combination of chemical and analytical structural approaches. It used to be thought that proteins fold to the most stable conformations; however, recently it has been found that the final folded conformation may depend on how fast it gets there and gets locked in to its final form. It has also been shown in model studies that the microenvironment seen by a given sequence during folding can override the secondary structure propensity of that sequence.

(2) Research Impacts

A major recent impact has been the development, patenting, and commercial production of instrumentation for an electron monochromator - mass spectrometer (EM-MS) system for the analysis of environmental compounds and pesticides. This instrument promises to become a powerful tool for detection and identification of trace amounts of environmental chemicals.

(3) Research Outcomes

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(4) Integrated Research

One of the objectives of the Mass Spectrometry facility is to provide mass spectrometric analysis support to other investigators through collaboration and services. Consequently collaboration with both basic and applied scientists from all over the University, as well as from other universities is wide spread. Collaboration and integrated research runs from simple analysis of a few samples, training students to operate the instrumentation, to full collaborative joint proposals for external funding.

Water: Quality, Quantity, and Management:

Environmental and Molecular Toxicology

Microbial Transformation of Trichloroethene (TCE) in Anaerobic Groundwater

(1) Research Overview

Chlorinated solvents, such as trichloroethene (TCE), have been used extensively as industrial degreasing agents and improper disposal or accidental leaks have led to groundwater contamination. As a result, TCE, which is a suspected carcinogen and neurotoxin, is one of the most frequently-occurring organic contaminants in groundwater. Current research activities focus on the development of analytical and field methods for measuring the in situ rates of organic contaminant transformation in contaminated groundwater. With these methods, we can determine if the addition of chemical amendments can enhance the rates of TCE transformation and, as a result, decrease the risk that this common groundwater contaminant poses toward humans

(2) Research Impacts:

The ultimate goal is to create a set of methodologies that can be applied at hazardous waste sites in order to characterize the level of contamination and the potential for remediation. Information obtained on the rates of organic contaminant transformation can be used for the purpose of designing remediation activities and minimizing their cost.

(3) Research Outcomes:

The application of these methods at a TCE-contaminated field site successfully resulted in the collection of data that definitively demonstrate that 'reductive dechlorination' is actively occurring in the contaminated groundwater at the field site. Reductive dechlorination describes a process whereby chlorine atoms are successively removed from TCE molecule and can proceed to the point where non-toxic products are produced. To the best of our knowledge, this is one of the first reports of in situ reductive dechlorination at a TCE-contaminated field site. These methodologies may ultimately replace more expensive and time-consuming technology for the determining the reductive dechlorination activity at TCE-contaminated field sites. The following publication resulted from this program:

Hageman, K.J., Istok, J.D., Field, J.A., Buscheck, T.E., and Semprini, L. In Press. In Situ Anaerobic Transformation of Trichlorofluorethene in a TCE- Contaminated Aquifer. Submitted to Environmental Science and Technology.

(4) Integrated Research:

The study is being conducted in collaboration with the Chevron Research and Technology Co who has technical over site at the TCE-contaminated field site. In addition, this study also is part of the Superfund Basic Research Center at Oregon Health Sciences University.

USDA Goal 5 - Empower people and communities, through research-based information and education, to address economic and social challenges facing our youth, families, and communities.

OSU Program 7: Rural and Community Development:

Agricultural and Resource Economics

(1) Research Overview

The AES research this year addressed four issues:

The economic role of agriculture in Oregon and the impact of agricultural production and processing on the economy of Oregon;

The impact of local labor markets in rural Oregon on the success of the working poor in increasing their earnings, and the jobless poor in getting jobs

The impact of state policy on poverty in Oregon

The impact of tax policy on the state economy and on the distribution of the tax burden among income classes in Oregon.

The analysis of the role of agriculture was completed using an economic model (Social Accounting Matrix) of Oregon that captures the importance of the public sector and households more completely than was possible in previous studies.

The econometric analysis of local labor markets and employment outcomes of low income workers was performed with a unique linked administrative database allowing the tracking of the impact of local job growth on individual workers employment and earnings history.

For the poverty policy analysis, we developed a dynamic simulation model that linked state policy options with poverty outcomes by household type, capturing the role of labor markets in escaping poverty

The tax policy analysis involved the development of a unique economic (computable general equilibrium) model for Oregon, and linking that with an analysis of the distribution of tax burdens across income classes, taking both direct taxes paid by households and business taxes shifted to households.

(2) Research Impacts

During the past year, both the models and the research results have been used by state agencies (Oregon Department of Agriculture, Oregon Department of Housing and Community Services, the Oregon Progress Board, for examples) and the state legislature. These entities have used the models to analyze and design policy. More broadly, the research has captured the attention of the public through newspaper articles reporting the results. This is most particularly true of the tax incidence results.

(3) Research Outcomes

Investigators at OSU worked with the Legislative Revenue Office to develop and maintain an "Oregon Tax Incidence Model" (OTIM) that allows the Legislature to understand the "feedback" effects of a change in taxes on personal income, and the distribution of the tax burden among income classes. The model was developed during the summer and fall of 2000 and is being used by the 2001 Oregon Legislature to analyze and design tax policy. It was used in March 2001, for example, to analyze and shape the Business Activity Tax (BAT) proposal of the House Revenue Committee, which would reform Oregon's tax system by replacing the corporate income tax with this BAT, reducing personal income tax rates, and providing property and income tax relief to low income households. The low income household property tax relief was added to the bill in part because OTIM showed how high property taxes were for the lowest income groups. The new ability to analyze distribution of tax burdens has affected the substance of tax policy.

The Department of Housing and Community Services has picked up the "Poverty Dynamics Simulation" model originally supported by the Oregon Progress Board and developed over the course of several years by OSU investigators Liz Davis, Carolyn Boggess, and Bruce Weber. DHCS will continue to develop it as an analytical tool with some input from OSU.

(4) Integrated Research

The work reported was collaborative with state agencies (Oregon Progress Board, Oregon Department of Housing and Community Services, Oregon Employment Department and the Legislative Revenue Office) and with researchers at several other universities (Washington State University, Ohio State University, University of Minnesota) associated with Regional Research Project NE-162, and several not associated with the Land Grant System (Northwestern University, University of Northern Colorado)

Home Economics

Accountability for Results for Community Initiatives

(1) Research Overview

A prior study produced a model and multiple measures for tracking the outcomes of specific prevention programs that contribute to Oregon's social and community goals and benchmarks. The current research addresses two objectives. Objective one is the further identification of outcome measurement strategies for program and community initiatives for children, youth, and families, especially those used in rural communities. Research activities have refined, applied and published retrospective pre-test methods useful for both program and community initiative; developed, analyzed and published strategies and methods for tracking outcomes for community child care programs; initiated literature review and conceptualization of measurable outcomes of community-wide mobilization initiatives in support of children and families. Four categories of measurable outcomes have been defined and related qualitative and quantitative measures are being identified, developed, and pilot tested.

Because of expanded work in support of objective one (above) during the first two years of operation, only initial planning has taken place for research on Objective two: Examination of factors associated with level of implementation and positive and negative effects of outcome-driven accountability in initiatives serving children, youth, and families. In 2001-02, data collection will be initiated following development of focus group and key informant interview protocols. Respondents will include state and community policy-makers, program staff, and community members in rural Oregon.

(2) Research Impacts

As demands for accountability increases, this work has the potential to impact the development, assessment and funding of education and human services programs throughout the state, region, and nation.

(3) Research Outcomes

Our results accountability model and related resources are the basis of the performance measurement policies and practices for the Oregon Commission on Children and Families and all 36 county commissions, the Oregon Child Care Bureau, and the Oregon Tobacco Prevention and Cessation Program (Oregon Health Division). The model and resources have been used by: University of Illinois – Champaign; US Child Care Bureau; National Association of Child Care Resource and Referral Agencies;. 2000-01 publications included two referred journals (American Journal of Evaluation; Child Abuse and Neglect), one nationally distributed book (Results Accountability for Child Care Resource and Referral Agencies.)

(4) Integrated Research

OSU colleagues informing this work include faculty in Extension Family and Community Development, Extension Personnel and Organization Development, Public Health, and Human Development and Family Sciences.

5. Total expenditures by source of funding and FTE for each Goal

See Appendix A for expenditures and sources of funding and FTE for each Goal according to instructions on form CSREES-REPT (2/00) Supplement to the Annual Report of Accomplishments and Results.

B. Stakeholder Input Process

The OAES continues to utilize the format stated in the POW and obtain clientele input at the different levels of our programs on a regular basis.

The Oregon Agricultural Experiment Station (OAES) annually utilizes multiple means of obtaining stakeholder input on programs conducted and solicits input on changes in program direction. The OAES supports research in 12 departments on the Oregon State University campus as well as at 11 off-campus branch research stations. Programs at the research stations are administratively responsible to the Director of the OAES and coordinate with one or more academic departments. Each year, most college departments and all off-campus research stations hold a meeting with their Advisory Boards where research results and policy issues are presented proposed programs are discussed and input sought from the members. It should be noted that many of the programs discussed involve scientists located on the Corvallis campus as well as those at the off-campus research stations.

There are a variety of stakeholders that have input to OAES research activities. They include: the Dean's/Director's Advisory Council consisting of about 12 members that represent a variety of groups within the state representing producers, processors, and environmental groups. During these biannual meeting OAES programs are discussed and input is solicited on future priorities for research and educational activities in the college. The State Board of Agriculture appointed by the Governor (the Dean is an *ex officio* member) provides input to the Dean about priorities in Oregon's agriculture. Constitutionally driven advisory committees established by college departments and branch stations meet with faculty and administrators each year for a review of programs and help establish research priorities for the departments, often with respect to types of faculty to hire that meet the needs of the state. Depending on the OAES unit, these advisory groups consist of from 8-12 representatives with diverse backgrounds that best meet the needs for a broad set of inputs to research activities in the OAES unit. In OAES units that conduct considerable applied field research, the advisory groups usually include predominately producers of commodities served by the unit. In units that have a significant amount of their faculty engaged in value-added and basic research, advisory groups have representation from relevant industries that are interested in these types of research, both public and private. There is a turnover of representative each one or three years in order to bring inputs from new members.

On at least a biennial basis, the Dean calls a meeting of representatives from state agencies, commodity groups, processors, and OAES administrators, to discuss OAES programs and tentative priorities in order to get feedback from them about research priorities they feel are important. This information is recorded and discussed with OAES administrators with the purpose of determining how we can best meet the needs of the stakeholder group.

One important stakeholder group consists of all commodity commissions and other commodity groups (usually with 8-12 members) that fund various aspects of OAES research. There are 32 State of Oregon Commodity Commissions and 20 other commodity related organizations, most of which provide funding for research projects. Through the process of reviewing proposals from involved OSU scientists and the College Dean's representative to these groups, there is a distinct set of annual priorities established for research in each of the programs. All Oregon commodity commissions have a state mandate on representation for each group. Each year the groups that provide research funds to the OAES seek project proposals based on their own priorities from interested and capable scientists. The industry group committees review and comment on the proposals and fund those that relate to their priority needs. If they don't fund some proposals, they let us know why. Thus, through this process we get direct feedback on priorities on a very broad cross section of commodities in our state. Following completion of research funded by the commodity groups our scientists report their finding in open meetings with the group and we get feedback from them on the value and direction of the activities, thus enabling us to better meet their needs in subsequent years. All commodity groups are interested in selling their products, maintaining good public relations and in keeping the natural resources used to produce the crops in good

condition. Thus, they set their research priorities not only on higher production, but also on maintaining the resources from which the commodities are grown.

Stakeholders within Oregon primarily consist of those that fund OAES research activities. Nevertheless, OAES stakeholders are many and varied, and have very significant inputs to the research activities conducted by our scientists. They include: commodity groups, foundations, state agricultural and natural resource agencies, Department of Environmental Quality, Health and Human Services, etc. Each of these agencies establishes their priorities and OAES research funding is dictated by those priorities. The point here again is that OAES priorities are often driven by the priorities established by other agencies, and our mission is to respond as best we can with facilities and faculty, to the overall needs of the state. In the process of interacting with these agencies, both at the scientist and administrator level, we are able to meet significant demands of our overall OAES mission. Members of these groups vary considerably with respect to the groups or areas they represent, and rotate off the group periodically. Thus, about all that can be said about composition of each of these groups is that members represent the interests of the individual stakeholder group and overall represent a vary broad cross-section of interests in the state of Oregon.

On at least a biennial basis, the Dean calls a meeting of representatives from state agencies, commodity groups, processors, and OAES administrators, to discuss OAES programs and tentative priorities in order to get feedback from them about research priorities they feel are important. This information is recorded and discussed with OAES administrators with the purpose of determining how we can best meet the needs of the stakeholder group.

The SAES directors hold annual research reviews of our cereal research and extension programs in the northwest tri-state area that includes involved faculty and commodity groups. As a result of these reviews, research and extension faculty get a better insight into production and marketing issues in the region, and the participants from various aspects of the cereal industry have an input to research and extension program priorities.

The OAES also relies heavily on the 5-6 year cycle of CSREES reviews of our departments and branch station activities. These reviews provide a significant outside viewpoint about the units; what they are doing; what they should be doing; and how we could get from here to there. Follow-up discussions are held by college administrators with administrators and faculty within each unit after the CSREES review and a course of action is mapped out that will enable us to better respond to current needs in the research areas covered by the unit.

It is difficult under the conditions used in the OAES to determine under-served or under-represented audiences. One of the challenges is that, except for a few limited areas, there are few minority groups engaged in agriculture in most areas of Oregon. Minority input comes through a variety of agencies that affect our research programs and administrators and faculty members interact with people of color, American Indians, women, underprivileged, etc. These interactions take place in different fora, but nevertheless have input to our research programs. At any given time it would be difficult to determine exactly how many "under-represented" groups are involved in OAES activities. We have strong ties with Indian tribes both in research and extension programs. The Oregon Women for Agriculture has been involved and supportive of OAES research for many years. Our Home Economics programs and rural sociology programs interact with and are responsive to under-privileged individuals and groups in different parts of the state, e.g., inner city, coastal fisheries, timber communities, etc. In addition, other minority groups are represented within agencies that are involved in OAES research activities. The Malheur Experiment Station is noted here as an example of our branch research stations advisory groups. Advisory Board members represent the various agricultural production groups, i.e., agro-ecological areas and crops in the Treasure Valley of eastern Oregon. Minority groups in Malheur County include Asians, American Indians, Hispanics, and Spanish Americans who are descendants of shepherders who came to this country in the 19th century. At any given time one or more of these groups are represented on the station Advisory Board. Thus, we attempt to be inclusive on the Board and responsive to the needs of the various interest groups in areas like Malheur County.

As the case with other funding agencies for research such as NSF, USDA-NRI, NIH, etc., the agencies establish their priorities by whatever means is best suited to the agency. The people they select to assist them in setting priorities are of their own choosing, and we have no input to the process. We have to assume that the group or process they utilize to establish priorities is sound with respect to the goals of the agency. These agencies solicit research proposals that respond to those priorities, are peer reviewed by a group selected by the agency, and fund research that is deemed to be most worthy within the constraints of the agencies priorities. The OAES, like other SAES rely heavily on outside research funds to support research by their scientists. Thus, many of the "priorities" established for SAESs are established in a variety of ways by a wide variety of agencies that must be relied upon to be sound according to the agencies that provide grant support for research. The point here is that the process that takes place at the national level, applies to funding agencies within each state as well. Administrators interact as best they can with state and federal agencies, but they have little direct voice in the priorities that are set by these groups. And the priorities set by these agencies greatly affect the direction of research programs in the OAES as our recurring state and federal funds essentially support faculty and staff salaries with little left over for operational funds. Thus, faculty choices on research direction are driven to a great degree by the priorities of agencies that fund their programs. The good news is that although the OAES has relatively little input to this priority setting process, the practical matter is that sound methods are being used within the agencies to include a wide range of interest groups in order to set priorities. The OAES takes satisfaction that through the mix of granting agencies from whom we receive research funds, we are addressing researchable problems that have been deemed important to the local, state, regional and national cross-section of interest groups that had direct input to the priorities.

Stakeholder Inputs:

College of Agricultural Sciences Administration

The College of Agricultural Sciences Advisory Council provides advice and suggestions on the various programs of the college. The College of Agricultural Sciences Legislative Task Force is a committee that operates through the College Advisory Council.

College of Agricultural Sciences Dean's Advisory Council Meeting Minutes:

One major outcome of that meeting was a conversation around a vision statement for the College. The essential elements that were identified are as follows:

Elements of a vision statement for the College of Agricultural Sciences

- ◆ Creates and disseminates knowledge
- ◆ Prepares students for the future
- ◆ Integrated
- ◆ Interdisciplinary
- ◆ Responsive
- ◆ The premiere (most respected) source of information about agriculture and natural resources
- ◆ Flexible to explore options
- ◆ Teaches good stewardship
- ◆ Accountable
- ◆ Responsible
- ◆ Able at effective communications
- ◆ Teaches sustainable resource management

The College's newest Advisory Council member contributed some additional suggestions regarding initiatives:

Initiatives (most of which the CAS is addressing, but continues to research)

- Conserving water
- Effect of agriculture on the hydrologic function
- Reducing erosion (not just in agriculture, but in other contexts)
- Reducing migration of pesticides into the water
- Ecological restoration: how to do it, flood plain and wetlands, share the expertise we put together about ecological restoration and treat it as an "export industry"
- Integrating habitat and agricultural production
- Develop alternative crops (with sensitivity to their ecological consequences)

At the conclusion of the meeting a "to do" list was developed, to be considered and initial preparations begun for our next joint meeting next year. Please be thinking about which task you would like to participate in and contribute to and appointment will be made well in advance of the next meeting.

The E. R. Jackman Foundation is under the authority of the Oregon State University Foundation, but is dedicated to the support for College of Agricultural Sciences programs. The college representative of the E. R. Jackman Foundation met jointly with the Dean's Advisory Council in order to make a report of activities that have been made on behalf of the college.

Oregon State Legislative Update—Thayne Dutson, Dean and Jack Long, Council Chair.

Thayne and Jack provided a review of budget matters before the legislature; the budgets for the statewide public services have been well received.

Federal Activities

Jack Long and Mary Pearmine are the College's CARET (Council on Agriculture, Research, Extension, and Teaching) representatives. CARET meetings are held twice year—the Spring meeting includes visits to the state's Congressional representatives and their aides regarding current agricultural issues.

The Dean's Priorities

The Dean talked about the three major areas he has identified as the priorities for his efforts:

- 1) Making our knowledge and expertise available to more people in more different ways (teaching, Extension, and research).
- 2) Creating quality image high-value programs returning benefit to programs (sustainable)
- 3) Embracing practices in the College, communication-ability systems (running meetings, avoiding personal agendas, acknowledging each other, protecting and taking care of each other)

This prompted a discussion on the following topics:

- q What might be the College's next "ramp-up" mechanism for excellent programs?
- q Living the Dean's Agenda
- q Motivating faculty and department heads to higher achievement
- q What is the information that needs to be taught
- q Goal is to make a difference in the State of Oregon and Oregon State University
- q SB-1010, 303D listings, etc. Basin Water Plan, is a perfect example of a modular curriculum item
- q What each person is doing in the College needs to be related in some manner to the vision
- q Open space managers is an important concept
- q Curriculum update may best be done by a more local system for each degree

Issues facing agriculture during the next 10-20 years

- ◆ Endangered Species Act and how to better live with it
- ◆ Water quality/quantity
- ◆ Sustainable "systems" management (natural resources, ecosystems, personnel)
- ◆ Technology will drive agricultural systems in the future
- ◆ Affordable minor use pesticides (IR-4 programs)
- ◆ Application of chemicals via weather stations measuring microclimates and computer reminders (time to spray for codling moths)—environmentally sound, saves money. "Precision agriculture"
- ◆ Labor issues
- ◆ Information gathering via Web site (OSU researchers should have their info on these sites) and information availability re: agriculture in general, on the Web
- ◆ Economic survival in a global economy
- ◆ Defending your right to exist
- ◆ Obtaining/retaining a positive image of agriculture.
- ◆ Internet product marketing (purchasing/selling)
- ◆ Communicate to public more effectively
- ◆ Communicate to/among growers more effectively
- ◆ Communicate marketing/advertising more effectively
- ◆ Communicate global accountability more effectively
- ◆ Open space—best defense to public image
- ◆ Being responsible, identifiable community members
 - Notify neighbors regarding spraying
 - Clean up muddied roads

- ◆ Efficient, economical transportation
- ◆ How to look successful (stereotypes)

Significant Outcomes from Stakeholders' Inputs (Dean's Advisory Council):

Discussions with the Dean's Advisory Council, as well as with college unit heads and other clientele resulted in the following AES supplemental funding package that was submitted to the Oregon State Governor and Legislature for the 2001 legislative session.

Economic and Environmental Sustainability in Agriculture and Natural Resources

Much of what makes Oregon attractive to its citizens—urban and rural—is influenced by the vitality of its food and agriculture sector and by wise management of its natural resources. Environmental sustainability and economic sustainability are central. Oregon Agricultural Experiment Station research is a key source of new knowledge that addresses both management of Oregon's natural resources, and economic viability in food and agriculture.

Oregon Shines II Goal 1: Quality jobs for all Oregonians
 Goal 3: Healthy, sustainable surroundings

This research and outreach initiative:

- **Develops viable economic and management models** for Oregon agricultural businesses, helps them embrace new precision technologies and develop foods and other products that respond to growing consumer attention to healthfulness and safety. It also **develops new knowledge supporting the environmental sustainability of agriculture** addressing, for example, such matters as watershed protection and management, invasive species, and development of disease-resistant crops. Components include (1) **sustainable food and agriculture production systems** focusing on environmentally sound pest control, integrated management systems, new and specialty crops, value-added products, labor efficiency and mechanization. All are areas where producers and processors are recognizing both need and opportunity to make changes that will advance their economic sustainability; (2) **advanced genetic capability and precision production technologies** focusing on applying dramatic advances in biological science and microprocessors to create custom-designed products for specific consumer needs, and development of innovative agricultural products on which Oregon can capitalize by meeting new markets; and (3) **food safety and health**, focusing on two areas: safety of the food supply broadly and consumer interest of healthfulness of individual foods.

- **Advances a systems-based understanding of natural resources and water**, and knowledge of the interrelationships among elements of ecosystems. New, useful knowledge about water quality and waste management is developed for use at the site level (such as farm or ranch), while watershed-wide information focuses on stewardship and biological diversity.

- **Provides new knowledge to help farms and rural communities** identify and embrace sustainable strategies for economic development, and to aid elected officials and agencies in formation of public policy alternatives for long-term sustainability.

C. Program Review Process

The OAES regularly invites CSREES to cooperate in conducting departmental and program reviews. During FY 2000 the Animal Science and Rangeland Resources Departments were reviewed. There has not been sufficient time for any significant changes in the research programs to be made in those units in response to the recommendations from those reviews. Most of the comments for both units dealt with recommendations to continue to facilitate research programs as they are now directed, and continue to attempt to garner additional financial support for research programs. Needless to say, funding is a perennial limiting factor in all of our research units, but we continue to seek additional funds from a variety of sources.

D. Success of Multistate Activities

The OAES 1999 POW contributes to many multistate projects under each of the seven programs. Each of those multistate projects and committees submits reports on their activities, accomplishments and plans for the future each year. The OAES makes no attempt to evaluate any of those multistate research activities as that is accomplished through the efforts of the scientists and administrative advisors in each of those programs. Regionally, the Research Implementation Committee is responsible for evaluating each new or revised proposal for projects and committees and the AES directors approve or disapprove them based on the recommendations from the RIC.

Statements within the individual research areas reported above relate information about their involvement in multistate activities regarding scientist to scientist and state to state (or agency) cooperation.