Oregon State University | Agricultural Experiment Station

Plan of Work

Annual Report of Accomplishments and Results

Oregon Agricultural Experiment Station
Oregon State University

Federal Fiscal Year 2004

Thayne R. Dutson
Dean, College of Agricultural Sciences
Director, Oregon Agricultural Experiment Station

Table of Contents

Table of Contents i

A. Planned Programs 1

Goal 1. **An agricultural system that is highly competitive in the global economy** 1

OVERVIEW 1

ASSESSMENT 1

TOTAL EXPENDITURES 2

TOTAL FTE 2

ACCOUNTABILITY 2

Key Theme: Agricultural Competitiveness 2

Key Theme: Agricultural Profitability 3

Key Theme: Animal Health 5

Key Theme: Animal Production Efficiency 7

Key Theme: Biobased Products 8

Key Theme: Biotechnology 9

Key Theme: Organic Agriculture 10

Key Theme: Plant Genomics 10

Key Theme: Plant Health 11

Key Theme: Plant Production Efficiency 14

Key Theme: Precision Agriculture 18

Key Theme: Rangeland/Pasture Management 19

Goal 2. **A safe and secure food and fiber system** 21

OVERVIEW 21

ASSESSMENT 21

TOTAL EXPENDITURES 21

TOTAL FTE 21

ACCOUNTABILITY 22

Key Theme: Food Quality 22

Key Theme: Food Safety 24

Goal 3. **A healthy, well-nourished population** 26

OVERVIEW 26

ASSESSMENT 26

TOTAL EXPENDITURES 26

TOTAL FTE 26

ACCOUNTABILITY 27

Key Themes: Human Health 27

Goal 4. **Greater harmony between agriculture and the environment** 30

OVERVIEW 30

ASSESSMENT 30

TOTAL EXPENDITURES 30

TOTAL FTE 30

ACCOUNTABILITY 31

Key Theme: Hazardous Materials 31

Key Theme: Integrated Pest Management 32

Key Theme: Natural Resource Management 33

Key Theme: Nutrient Management 34

Key Theme: Soil Quality 35

Key Theme: Water Quality 37

Key Theme: Wetlands Restoration and Protection 38

Goal 5. **Enhanced economic opportunity and quality of life for Americans** 40

OVERVIEW 40

ASSESSMENT 40

TOTAL EXPENDITURES 40

TOTAL FTE 40

ACCOUNTABILITY 41

Key Themes: Children, Youth, and Families at Risk 41

Key Themes: Consumer Management 42

Key Themes: Impact of Change in Rural Communities 42

B. Stakeholder Input Process 44

C. Program Review Process 46

D. Evaluation of the Success of Multi and Joint Activities 46

E. Integrated Research and Extension Activities 48

Appendix C (Form CSREES-REPT) 58

FY2004 Annual Report of Accomplishments
Oregon Agricultural Experiment Station

A. Planned Programs

NATIONAL GOAL #1: An agricultural system that is highly competitive in the global economy. Through research and education, empower the agricultural system with knowledge that will improve the competitiveness in domestic production, processing, and marketing.

OVERVIEW

The Oregon Agricultural Experiment Station (OAES) has 182 **projects** with 20 key **themes** under the National Goal #1 in the CRIS database. We selected 41 **projects** from 12 key **themes** to highlight in this year's report. The major selection criteria are the quantifiable outcome and impact. We provide only the summary output data in this section, and will present outcome and impact information under individual key themes below. Review comments from a previous report indicated a redundancy in reporting our outcome and impact statements. Therefore, we have decided not to present the outcome and impact statements in the overview section. Those units which conducted the research with quantifiable impacts are identified within each key theme to encourage our units to write better outcome and impact statements in future years. When appropriate, details of the calculations used to derive the economic impact are presented to substantiate the claim.

Research results have been shared through refereed journal articles, abstracts, books and book chapters; theses, local, regional, national and international meetings, symposia and workshops; GIS climate, geophysical and plant maps; and an array of web pages of an array of types.

- Published 325 **refereed** journal articles, 4 **books**, 37 **proceedings** papers, and 21 **abstracts**.
- Made 18 **presentations** at national, international, and professional meetings.

ASSESSMENT:

All units in the Oregon Agricultural Experiment Station are required to conduct annual performance evaluation of their faculty members. These annual reviews are conducted based on goals established during previous year's reviews. Since all faculty members with OAES FTE are required to establish their station projects, annual performance evaluation

serves a good vehicle to assess our progress toward the goals in our plan of work. OAES has made good progress in meeting these goals.

TOTAL EXPENDITURES:	$19,503,445
Hatch:	$1,146,205
Multistate:	$587,057
State:	$17,770,183

TOTAL FTE:	114.2

ACCOUNTABILITY:

Additional information regarding research programs conducted through the Oregon Agricultural Experiment Station may be found in *"Oregon Invests"*, a research accountability database accessible on the web at:

http://oregoninvests.css.orst.edu

There are currently over 346 reports contained in the database, searchable by selected criteria. Each report undergoes systematic professional review with analysis of projected economic, environmental and social effects, as appropriate.

Examples of search topics for Goal 1: disease resistance, pest management, genetics, irrigation, plant pathogens, genomes, biotechnology, sperm mobility, seafood processing, wheat cultivars, and pollination management.

KEY THEMES

Key Theme: Agricultural Competitiveness

ISSUE OR PROBLEM

Dairy farming in the U.S. is jeopardized by the decline of milk prices and concern about the impacts of dairy farm nutrient losses. A world market price for milk is causing larger dairy farms to be concentrated in certain geographic locations, which in turn concentrates manure and amplifies nutrient loads. Managing manure nutrients is a cost assumed by the farm owner. Dairy farmers must reduce nutrient losses from their farms while maintaining economic profitability through increased production efficiencies. The Department of **Crop and Soil Science** is developing integrated research and technology transfer programs to help dairy farmers better manage their farms in a cost effective and environmentally acceptable manner that complies with newly imposed farming regulations.

The Pacific Northwest (PNW) has a need for new blackberry, raspberry, and wine grape cultivars. The Department of **Food Science & Technology** is focusing on the flavor chemistry of blackberry, raspberry and wine grapes to develop high quality cultivars and to improve flavor development during grape maturation.

IMPACT

To help dairy farmers **Crop and Soil Science** efforts have focused on optimal forage species selection, including species suitability maps based on climate and soil factors. These maps are helping seed industry representatives, farm advisors, and land managers to choose highly suitable species for dairy systems. The result will be higher yields and greater recycling of nutrients which will address both the profitability and environmental concerns of farmers and the general public.

The work by **Food Science & Technology** faculty will provide better understanding of the flavor chemistry and consumer flavor preference of blackberries and raspberries. The results can be used by the berry industry to evaluate and market new cultivars. In addition, the study will result in a berry flavor databases related to aroma chemistry and volatile composition. This database will be very useful in planning breeding, plant management, determination of optimum harvesting time and product quality improvement. For example, the raspberry fruit quality evaluation will directly help the raspberry industry develop cultivars with summer-bearing, high-yield, winter hardy, machine harvestable, disease resistance, virus resistance and have superior processed fruit quality.

Scope of Impact – State, regional, national

Source of Funding - Hatch, State, Smith-Lever, commodity funds, USDA competitive grants

Key Theme: Agricultural Profitability

ISSUE OR PROBLEM

Oregon whey powder is a low price commodity product even though it is well-documented that it is made from high quality milk. The Department of **Food Science & Technology** is investigating the unique properties of Oregon whey powder to evaluate potential competitive advantages. The effect of variability in processing parameters will be investigated to optimize the whey powder.

The beef cattle industry in Oregon has been a major contributor to the economy of the state and to rural communities. The diversity of the state's topography and climate has allowed for nearly every area of the state to be involved in the cattle industry in some fashion. However, the structure of the meat industry is making it increasingly difficult for meat animal producers to maintain viable operations. Due to the wide-spread impacts of the cattle industry on the state of Oregon, rural communities, policy makers, and producers have begun to increase the attention given to the impacts of changes in the livestock industry and to search for methods to sustain production as a means for long-term viability of rural communities. The purpose of this **Agricultural and Resource Economics** project is to increase meat producers' competitiveness and profitability through value added activities.

As resources decline, communities and agencies seek to prioritize restoration planning efforts and to prioritize lands for conservation acquisition. The Department of **BioEngineering** will assist resource managers and stakeholders utilize decision support tools, such as RESTORE and EvoLand, to better understand processes in a range of

ecological systems, and allow incorporation of scientific understanding into management and stakeholder decision-making.

New entrants to the processed food industry can provide market alternatives for small to medium sized farms. However, more often than not, these new entrants are faced with the Herculean task of being successful with limited knowledge, employees and capital. This **Food Innovation Center** project will identify management processes and activities that will help new entrants to the processed-food industry.

The new emphasis on the production of fruit for the fresh market requires the mid-Columbia sweet cherry industry to undergoing a radical transformation in orchard production methods. The **Mid-Columbia Agricultural Research and Extension Center** is developing production systems that will optimize high-quality fruit yields for maximum economic returns, using recently available self-fertile cultivars, dwarfing rootstocks and new tree training methods.

Thiabendazole treatment is commonly used in the pear industry to control postharvest decay. However, the range of pathogens controlled by thiabendazole is limited, and there is significant incidence of thiabendazole-tolerant strains among major pathogens. Furthermore, thiabendazole residues are not acceptable in some export markets and a perceived market demand for fungicide-free fruit has created the need for alternative decay management strategies. The **Southern Oregon Research and Extension Center** will define alternative strategies to thiabendazole treatment.

IMPACT

This **Food Science & Technology** study documents that the quality of Oregon whey powder is of excellent and consistent quality. The information will allow Oregon's whey processors to demand a premium price for their product. A conservative estimate of net gain to Oregon processors is $800,000/year.

Previous research has investigated regional impacts of the Oregon beef cattle industry on Oregon's economy but it is difficult to draw inferences about the impacts on the cattle industry based solely on this aggregate, regional-level analysis. The Department of **Agricultural and Resource Economics** is working to develop county-level data that would allow for a more sophisticated analysis of changes in the beef cattle industry and for a more accurate assessment of the impacts of potential changes in the beef cattle industry on the state of Oregon. This is of particular importance to those involved in agricultural, natural resources, and community economic development issues, including state and local government agencies, policy makers and private interest groups.

The RESTORE tool is being used by several groups to prioritize restoration planning efforts. Additional regional groups have begun using the RESTORE tool this year. EvoLand will be used for development planning in floodplain regions in the Willamette Basin. The Department of **BioEngineering** has identified and worked with a number of state and federal agencies and NGO's in the development of the Sustainability Decision Support System and it is anticipated that when completed it will become a valuable planning tool for these stakeholders. Further, this project has become a vehicle for regional collaboration with five other PNW research institutions, developing synergistic approaches to assessing trajectories of change in land, water, and human systems with respect to sustainability

issues. BioEngineering is working with NRCS and public/private partners on an irrigation scheduling tool that should significantly improve agricultural water use efficiency in the region.

The initial research by the **Food Innovation Center** on educational needs of new food industry entrants will be written up as a guide other programs across the U.S. in developing training programs targeted at this group of stakeholders. A presentation and paper on lessons learned from interviews with food companies will help people see a pragmatic way to approach an otherwise daunting task, helping them to start their business and increase the odds of being successful.

Research findings by the **Mid-Columbia Agricultural Research and Extension Center** on new rootstock and cultivar performance, training systems, chemical bloom thinning, irrigation management and protected cultivation in plastic tunnels will increase the profitability of sweet cherry cultivation by maximizing production of high-quality fruit. Methods to better manage/conserve irrigation water are expected to increase water use efficiency, improve weed and disease control and help maintain groundwater quality. Defining fruit growth stages will help fine-tune timing of practices aimed at attaining maximum fruit size (i.e., fruit thinning, irrigation, growth regulators, etc.) for different cultivars. Information on how fruit maturity stage at harvest affects quality in storage will help growers make more reliable decisions about the timing of harvest operations for different cultivars. Trees inside plastic tunnels will be protected from rain and wind and are expected to produce high pack-outs of premium quality fruit.

Identification of new decay management practices by the **Southern Oregon Research and Extension Center** would benefit producers and consumers by reducing losses to decay while broadening the market potential of stored pears. Sequential combinations of "soft" techniques may be the best way to achieve decay control without using a postharvest fungicide. Early results indicate several promising alternative postharvest treatments.

Scope of Impact – State, regional, national, and international

Source of Funding - Hatch, State, Smith-Lever, USDA competitive grants, Environmental Protection Agency, Agricultural Research Foundation, commodity funds

Key Theme: Animal Health

ISSUE OR PROBLEM

Metabolic diseases such as pulmonary hypertension syndrome, cardiopulmonary disorders and sudden death syndrome are the major cause of mortality in broiler chickens, and cost the U.S. poultry industry over $100 million annually. The etiology and pathogenesis of metabolic diseases is not clearly understood, but has been attributed, at least in part, to intense genetic selection for fast growth rate, resulting in cardiac damage, failure of the cardiovascular system and death. Normal broiler diets are high in saturated and omega-6 fatty acids and are low in omega-3 fatty acids. This dietary imbalance and underlying requirement for omega-3 fatty acids for tissue incorporation during growth, may

ultimately contribute to the development of conditions that predispose broiler birds to metabolic diseases. The Department of **Animal Sciences** will examine the role of maternal diet in modulating the lipid metabolism in progeny and characterization of the molecular mechanisms by which maternal fatty acids affects fatty acid metabolism in hatched chicks.

Complex systems present a significant challenge to managing natural resources. This project by the Department of **Fisheries and Wildlife** will develop mathematical and practical tools to predict the behavior of complex systems.

In the PNW region, several myxozoan parasites cause diseases that affect cultured and wild salmon and trout: *Ceratomyxa shasta*, the cause of ceratomyxosis; *Tetracapsuloides salmonae*, the cause of proliferative kidney disease; and *Myxobolus cerebralis*, the agent causing whirling disease. As a result of demonstrated impacts on aquaculture and wild fisheries, research on myxozoans has expanded rapidly during the past decade, particularly in the areas of molecular diagnostics. This has increased our capacity to detect parasite infection, but without complementary immunological tools we cannot interpret the significance of this information. *Ceratomyxa shasta* continues to cause high mortality in trout and salmon in certain rivers of the PNW and assumptions about the resistance of many salmonid strains are being challenged. An assay developed by the Department of **Microbiology** would add to the research toolbox, allowing researchers to resolve the role of a specific immune response in the development of resistance to the parasite in salmon and trout.

Animal performance on endophyte-infected tall fescue is poor due to problems such as summer syndrome, fescue foot, and fat necrosis. The economic losses to the U.S. beef cattle industry due to reduced conception rates and weaning weights of animals grazing endophyte-infected tall fescue has been estimated at $609 million annually. The purpose of this **College of Veterinary Medicine** project is to develop a probiotic or feed additive comprised of anaerobic microbes that will protect susceptible livestock species from toxic effects of endophyte-infected tall fescue.

IMPACT

Preliminary studies on metabolic diseases by the Department of **Animal Sciences** show that an increase in the retention of n-3 fatty acids in the cardiac tissues of chicks is due to maternal nutrition. Understanding the biochemical and nutritional effect of maternal diet may open new avenues in animal as well as human nutrition. Such findings will generate new knowledge about the fundamental relationship between maternal diet, fatty acid metabolism and metabolic diseases. This will have important practical implications for improving bird health productivity and will bring increased economic returns to U.S. poultry industry. Positive findings could be rapidly incorporated into the poultry industry simply by changing feed formulation.

In 2004, **Fisheries and Wildlife** faculty suggested a novel assay for toxicology assessment in salmon communities and for predicting changes in the risk of disease transmission. At the present time, cost estimates on the approaches have not been developed; however, the researchers believe that the approaches will be cost effective. Efforts to help managers and public health workers increase their effectiveness are vital to the continued health of agriculture in the PNW and worldwide. On the strength of published theoretical

studies, the lead investigator has been invited to participate in a United Nations Development Program sponsored scenario building exercise to address the impact of global climate change on human and ecological health.

The Department of **Microbiology** has developed an assay to detect circulating antibodies against *C. shasta* in trout. The assay has been optimized using laboratory reagents, and is currently being tested using samples collected from naturally and experimentally infected trout. This information has been used for preliminary data in the development of a proposal to investigate the genetic architecture of disease resistance in salmonids. Efforts to understand the functional mechanisms for pathogen resistance in trout will increase our ability to assess what approaches would be effective in the control of ceratomyxosis and related myxozoan infections. If further development is successful, this technology will aid the understanding of disease impacts that are occurring in critical fisheries in the region.

The **College of Veterinary Medicine** proposes an agricultural solution to a $30 billion clean-up problem. Alkaloids in endophytes are the number one plant-associated toxins in the U.S.; they are responsible for over $860 million in annual losses to the beef cattle industry. The Oregon Ag-Fiber Association also ships over 500 million tons of tall fescue and perennial ryegrass straw overseas as livestock feed which represents a $60 million industry in Oregon and a $350 billion industry in the western U.S. Pyrrolizidine alkaloids in the common weed tansy ragwort (*Senecio jacobaea*) are responsible for $20 million in economic damage to livestock in the PNW alone. The right anaerobic ruminal microbes will degrade the nitrogenous-ring toxic endophyte and pyrrolizidine alkaloid molecules after they are diffused out of the plant fiber and before they penetrate the rumen wall to go systemic. This will prevent livestock toxicosis from the ingestion of tansy ragwort and endophyte-infected grasses. Further, rumen microbial degradation of the nitrogenous ring structure of TNT may make it possible to detoxify soil environments contaminated with munitions.

Scope of Impact – Regional and national

Source of Funding - Hatch, commodity funds

Key Theme: Animal Production Efficiency

ISSUE OR PROBLEM

Artificial insemination is a critical tool for the reproductive management of poultry, with semen representing an important operational cost. The Department of **Animal Sciences** is examining the physical basis for profound differences in sperm mobility. Proteomics will be used to identify proteins critical to sperm cell motility. Ultimately, genes will be identified that control male fitness (i.e., reproductive success).

IMPACT

Understanding that calcium cycling underlies sperm motility should provide a new and useful theoretical basis for sperm cell preservation. It now appears that maintaining

mitochondrial function may be a better goal than maximizing post-thaw motility, which is the traditional goal of cryopreservation research. Male fitness in galliform birds can be altered by genetic selection when sperm mobility is the selection criterion. Furthermore, the mitochondrial genome must be taken into account. A heritable single nucleotide polymorphism was revealed by sequencing the mitochondrial genome in low and high sperm mobility lines. While this mutation may not account for low sperm mobility in all galliform birds, Animal Science experiments nonetheless demonstrate the potential for using restriction fragment length polymorphism analysis as a means of identifying males at hatch with distinct reproductive potentials.

Scope of Impact – National and international

Source of Funding - Hatch, State, USDA/CSREES special grants, National Research Initiative competitive grants, private foundations

Key Theme: Biobased Products

ISSUE OR PROBLEM

By 2025 global energy demand is expected to have increased by 60% from present, growing to about 640 quadrillion BTU (quads) per year, up from 404 quads in 2001, with most of that demand to be met by fossil fuels. But with nearly two-thirds of proven oil reserves located beneath Saudi Arabia and its neighbors, the U.S. and other nations must rely increasingly on the politically volatile Middle East for oil. Also, as economies of China, India, and other populous countries grow, competition for oil will likely increase. Further, global energy demand will produce more than 11 billion tons of CO_2. Therefore, clean, safe, and sustainable energy sources are needed to meet projected demand, to provide energy and economic security for the U.S. and other nations, and to relieve environmental stresses, including global climate change, related to fossil fuel use. Hydrogen (H_2) can play a major role in meeting energy demand, mainly as an energy carrier for fuel cells, but clean and environmentally sustainable ways of producing hydrogen are needed. The purpose of this **BioEngineering** project is to develop bacterial strains to produce hydrogen efficiently and sustainably at high rates.

IMPACT

Fuel cells afford efficiency and environmental advantages that are driving a transition to H_2-based technologies, especially in the automobile, oil, and energy producing industries, but industrial H_2 production at present is mainly from fossil fuels via non-sustainable technologies, such as steam reforming. Producing H_2 in this way is undesirable not only because it relies on a finite and nonrenewable resource but also because it generates CO_2. However, using microbes or enzymes to produce H_2 from water, using sunlight as an energy source, or from renewable carbonaceous materials, can meet societal energy needs while preserving environmental quality.

Scope of Impact – National and international

Source of Funding – Hatch, State, National Renewable Energy Laboratory, Oregon Department of Energy

Key Theme: Biotechnology

ISSUE OR PROBLEM

The Department of **Crop and Soil Science** is investigating the relationship between microorganisms involved in cycling soil nutrients and the factors that control their activity to better understand how carbon and nitrogen are cycled in soil. This understanding is important for sustaining productivity and maintaining environmental values.

University-business relationships appear to influence the dimensions and objectives of university bioscience research. This **Agricultural and Resource Economics** study assesses university-industry research relationships in agricultural bioscience.

IMPACT

The findings by the Department of **Crop and Soil Science** about microbial community and activity responses to disturbance and different plant communities may provide insights into understanding how microorganisms respond to such changes in natural and managed ecosystems. The research using ^{13}C-labeled plant materials was one of the first to trace carbon from complex substrates into the microbial community and provided new insights into the groups of microorganisms that are involved in the decomposition process. It is likely that other scientists will adopt this approach to studying decomposition processes in other ecosystems. The importance of this research has been recognized through invitations to speak at the annual meeting of the Soil Science Society of America, and at universities in the U.S. and Korea.

The **Agricultural and Resource Economics** study constitutes the first rigorous empirical examination, at the scientist level, of the factors influencing the types of research pursued in university agricultural biotechnology labs. The results will guide a number of policy decisions at the federal and university level. For example, while the typical Land Grant bioscientist does conduct more applied work than does the typical non-Land Grant professor, the claim that Land Grant research is oriented toward financially more capturable results -- as opposed to public or non-market benefits -- is not supported. The study also identified a range of policy initiatives that would influence research toward or away from immediate applicability, patentability, and particular crops and organisms.

Scope of Impact – National and international

Source of Funding - Hatch, State, National Research Initiative competitive grants, National Science Foundation

Key Theme: Organic Agriculture

ISSUE OR PROBLEM

In general, the Department of **Horticulture** seeks to find management practices that would reduce over-application of nitrogen (N), improve nutrient cycling, control erosion, and reduce weed pressure in orchard systems. Over application of nitrogen in orchard systems has been a common practice, and the movement of fertilizer derived nitrates into groundwater is a major concern. This particular project evaluates soil quality/biology and N uptake, utilization, and distribution in a range of alternative orchard floor management systems. The objective is to evaluate the effectiveness of alternative orchard floor management systems on soil quality, nitrogen uptake efficiency, distribution and recycling within the tree, and effect on pest populations, tree growth, yield and fruit quality.

IMPACT

In cooperation with a nematologist, wildlife biologist, post-harvest physiologist, plant nutritionist and economist, three years of data have been collected and analyzed from excavations of two research plots. In both locations compost increased organic matter more than any other amendment. In Corvallis, nitrates were most reduced in bark mulched soils. Trees grown in compost and bark amended soils are less dependent on N from fertilizer applications. When using soil amendments such as bark mulch and compost the amount of fertilizer required to meet the N needs of the tree is less. Although this does not represent a huge savings to growers, it does directly impact the amount of nitrates in the soil. One commercial fruit grower has implemented an experimental 3-acre compost trial as a result of this work. The Rinieri in-row-cultivator is often borrowed by an adjacent federal research facility after seeing our success on weed control using this method. Three years is not enough time to assess the cost effectiveness of soil improvement due to amendments. Initial inputs are costly but long-term payoffs are likely.

Scope of Impact – State, regional, and national

Source of Funding - Hatch, State, National Science Foundation

Key Theme: Plant Genomics

ISSUE OR PROBLEM

Hazelnut is well-adapted to the Willamette Valley, but current leading cultivars have noticeable weaknesses including susceptibility to eastern filbert blight and poor suitability to the blanched kernel market. This **Horticulture** project will develop new hazelnut cultivars and improve our understanding of hazelnut genetics.

Barley is an important crop and contributes key genetic diversity to U.S. agroecosystems. In this **Crop and Soil Science** project, genetic tools will be applied to real-world opportunities and constraints in order to maximize the profitability and sustainability

of barley production. For example, soil and water are two fundamental resources that must be conserved and fairly apportioned, respectively.

IMPACT

The recent discovery of eastern filbert blight in several locations in the southern Willamette Valley has growers keenly interested in new hazelnut cultivars with resistance to this disease. 'Lewis' and 'Clark', from the OSU hazelnut breeding program within the **Horticulture** Department, are now the most widely planted cultivars in Oregon. The quantitative resistance of these two cultivars allows hazelnuts to be planted where eastern filbert blight is present, and acreage in the Willamette Valley has remained constant at nearly 30,000 acres. The kernel quality of 'Lewis' and 'Clark' will also allow Oregon to compete effectively on the world kernel market. Our understanding of hazelnut genetics continues to improve, as quantitative traits, Mendelian traits, and molecular markers are studied. Microsatellite loci have been developed and are now ready for use in germplasm characterization, including the identification of duplicates in the collection. RAPD markers identified in earlier research are now used by the breeding program in marker-assisted selection for eastern filbert blight resistance. Several new sources of resistance have been identified and used as parents in breeding. Growers are optimistic that completely resistant cultivars will be released in the near future.

The Department of **Crop and Soil Science** developed new barley varieties with greater cold tolerance to better survive the winter, provide better ground cover and thus reduce soil erosion. Researchers are also addressing water apportionment issues by developing varieties that will require less irrigation. Crop diseases can be catastrophic to farmers and unhealthy for consumers, so developing barley varieties with durable broad spectrum resistance can reduce chemical use and stabilize productivity and quality.

Scope of Impact – State, regional, and national

Source of Funding - Hatch, State, USDA, National Science Foundation, commodity groups

Key Theme: Plant Health

ISSUE OR PROBLEM

Fire blight is the most serious bacterial disease of pear and apple trees; during severe epidemics, entire orchards can be lost. The addition of iron to a biological control bacterium can improve suppression of fire blight but iron does not always improve disease control. The Department of **Botany and Plant Pathology** will examine how to effectively use iron with biocontrol agents and antibiotics to consistently enhance disease control.

Tan spot of wheat is a destructive disease throughout major wheat growing areas of the world. This **Botany and Plant Pathology** research program investigates at the molecular level events that determine disease development in tan spot of wheat caused by the fungus *Pyrenophora tritici-repentis* (Ptr). Project goals include identification and characterization

of genes involved in disease development and host specificity, and mechanisms of susceptibility and resistance.

Field experiments with wheat stripe rust will be conducted by the Department of **Botany and Plant Pathology** to determine if epidemics spread at a constant or in an increasing manner in time and space, and how rates of disease spread are impacted by disease management practices (such as use of cultivar mixtures) in small experimental field plots versus larger-scale commercial production.

White rot disease, a fungus which permanently infests field soil, threatens to eliminate both garlic seed and onion seed production within this region within 10 years as it becomes more widespread in the region. This situation is repeated in other areas of Oregon, the Western U.S. and the world. The purpose of this **Central Oregon Agricultural Research Center** project is to learn how to control and/or eliminate white rot disease on *Allium* crops, such that infested fields may be replanted to *Allium* crops without fear of economical losses.

The carrot seed crop and harvested seed from central Oregon is abundantly contaminated by the bacterial blight pathogen, *Xanthomonas campestris* pv *carotae* (Xcc); such seed-borne bacteria are a potential source of epidemics of bacterial blight in commercial fields. Bacterial blight is only an occasionally damaging disease in carrot seed production, but Xcc-contamination of the seed crop occurs even without disease development. Infested seed is less preferred by commercial growers for whom bacterial blight may be damaging. The **Central Oregon Agricultural Research Center** seeks to better understand, control and manage several diseases which threaten both carrot seed quality and continued carrot seed production, one of the top valued crops in central Oregon and Washington, and which also have regional or even national and international implications.

Crown gall is a problem world wide and causes millions of dollars of damage each year in fruit and nut orchards, vineyards, and nurseries. Losses in Oregon alone are ~$400,000 in a typical year. Researchers in the Department of **Microbiology** have proven that its *Agrobacterium oncogene* silencing strategy to produce plants resistant to crown gall is effective in a commercially important species (apple). Other than the oncogene silencing strategy, no effective means exists to prevent or cure crown gall. However, the inability to move genes into plant chromosomes via homologous recombination is a serious technical limitation for biotechnology. Using current technology, DNA normally inserts at unpredictable locations, often disrupting important plant genes. Hundreds of lines must be tested to find a useful line. Transgenes introduced by homologous recombination would drastically reduce this effort.

IMPACT

In the PNW, oxytetracycline and BlightBan A506 (a biocontrol bacterium) are used to control fire blight. The Department of **Botany and Plant Pathology** showed that adding iron to A506 improves control of fire blight but the form of iron is important. Ferric chloride, ferrous sulfate, and Metalosate-FE (registered organic formulation) inactivates oxytetracycline, burns flowers, and ruins the pear and apple fruit surface. The iron chelate FeEDDHA (Sequestrene 138) did not damage flowers or fruit or interfere with

oxytetracycline. The new integrated program using iron-enhanced biological control technology (chelated iron combined with A506) followed by treatment with oxytetracycline provided superior disease control in orchard trials in 2004. If similar results are obtained in 2005, then growers may have a new and effective integrated management strategy for the suppression of fire blight of pear and apple.

Understanding the molecular genetics of toxin production by Ptr will provide insight into mechanisms of disease development. In turn, this information could be exploited for control of this wide-ranging and serious disease on wheat. Fungal plant pathogens that produce host-selective toxins (HSTs) are ideal organisms to address this goal. The HSTs produced by Ptr are unique because they are proteins. This genetic simplicity has greatly expedited efforts to characterize toxin production by this pathogen. While most of the work presently conducted in the **Botany and Plant Pathology** lab is considered basic research, the results of these studies have the potential to provide valuable information for the development of resistant wheat germplasm to this pathogen. Additionally, the information gained about this pathogen and mechanisms of susceptibility and resistance may have broader implications in the area of molecular plant-microbe interactions and impact agricultural production worldwide.

Results by **Botany and Plant Pathology** researchers suggest that control of many plant diseases may be greater in commercial production than in small-scale experimental plots. Further, disease control may increase as a control practice is deployed over increasing area. Highly similar results were obtained in rectangular and square plots, indicating that studies of disease spread do not always require square plots, which occupy very large areas and increase experimental expense.

Many fields in the western U.S. and worldwide have abandoned *Allium* production because of high soil infestation by white rot fungus. Irrigated application of low amounts of natural plant extracts to eliminate the white rot fungus from infested soil could be very cost effective, allowing replant of *Allium* crops without disastrous crop loss. The **Central Oregon Agricultural Research Center** researchers are optimistic that such a simple, cost-effective treatment could revitalize many fields, and prevent further white rot disease spread and intensification. In fact, based on preliminary results, many small traditional and organic onion and garlic growers already are applying natural stimulants and are successfully controlling white rot. More compelling data may be needed to convince large commercial industries and growers who take much larger financial risks.

The **Central Oregon Agricultural Research Center** is devising better control measures. For example, the usage of drip irrigation by area growers has already increased because of several factors, including net water savings, less labor during the otherwise busy mid-season and (in many cases) superior seed yields and germination; further conversion to drip irrigation may result from lowered amounts of the bacterial blight pathogen on seedlots, as other means of control of bacterial seed infestation by the seed farmer are not available. Suppression of Xcc on carrot seed plants by application of copper products is widely used, but research results suggest it may be of limited utility except perhaps to delay or protect from infestation of seedling carrots in the fall if well timed and repeatedly applied. Repeated application of chlorine via irrigation might have merit, but needs further investigation.

The oncogene silencing technology has the potential to prevent crown gall disease in any crop plant amenable to the introduction of transgenes; once gall-resistant transgenic rootstocks are produced, no additional input is required. The Department of **Microbiology** has discovered a new *Agrobacterium*-mediated pathway for gene transfer to plants by homologous recombination. Introduction of transgenes at specific chromosomal locations by homologous recombination would significantly reduce the cost of producing transgenic plants. The goal is to produce crown-gall-resistant rootstocks for grape, walnut, almond, and fruit trees using this technology.

Scope of Impact – State, regional, national, and international

Source of Funding - Hatch, State, Oregon Department of Agriculture, U.S. Forest Service, Bureau of Land Management, Environmental Protection Agency, National Science Foundation, National Institutes of Health, American Cancer Society, commodity funds

Key Theme: Plant Production Efficiency

ISSUE OR PROBLEM

Postharvest fungal decay causes serious losses in the winter pear industry of the PNW, especially in the Bosc cultivar. The **Southern Oregon Research and Extension Center** seeks to develop methods of reducing losses to postharvest decay in winter pears to facilitate successful long-term storage and marketing.

Columbia root-knot nematode (CRKN) infects potato tubers, producing defects that may cause entire crops to be rejected. Crops currently grown between potato crops increase nematode populations and nematicides must be used. CRKN may be controlled with alternative cash and cover crops that shrink populations, reducing the use of pesticides as well as the costs of nematode control. However, the economic risks of changing crops are unknown. **Botany and Plant Pathology** researchers must determine which alternative cropping systems control CRKN and are economically acceptable to growers.

To help PNW growers and processors remain competitive with foreign producers, notably Canadian growers, and other U.S. producers located much closer to market, the Department of **Crop and Soil Science,** the **Central Oregon Agricultural Research Center** and the **Klamath Experiment Station** are developing superior new potato varieties and improved management practices. Issues include increasing production costs, conservation of the environment and water supply, fertilizer and pesticide use, and varietal resistance.

Plants utilized in the most productive and least damaging manner is prudent, but decisions can be difficult. An abundance of knowledge is available and better selection can be aided with improved selection tools. **Crop and Soil Science** faculty will aid farmers improve agricultural productivity, manage natural resources, avoid disasters, and improve the environment to ensure sustainable development.

Cool-season grass seed production systems changed dramatically in recent years as residue management by open field burning was restricted. Alternative systems vary depending on the kinds of crops grown, soil type, slope and farm size. Defining management

practices for seed growers that are economically viable and environmentally sound is the goal of this **Crop and Soil Science** research project.

The climate of Oregon's Willamette Valley provides sufficient water for the normal development of grass seed crops during fall and winter. However, water deficit stress in spring during flowering and seed filling can limit seed yield of grasses in this region. Virtually no previous work had been done on spring irrigation of grass seed crops in Oregon or elsewhere in the world and very little information was available for managing irrigation in grass seed crops until the Department of **Crop and Soil Science** begin this project.

Early cropping may be a way for berry growers to recover a portion of planting establishment costs earlier than normal. However, over-cropping would reduce subsequent growth and adversely affect future production, particularly in the late-fruiting, heavy yielding Elliott blueberry. **Horticulture** trials examined the cumulative yield advantage of early versus normal cropping.

The release of new berry cultivars by the Department of **Horticulture** is expected to have a large impact on Oregon's berry production and processing industries. Further, the department provided the needed scientific background to optimize cultural practices for the integrated production of grapes. Research focused on grapevine irrigation and nutrition, evaluation of phylloxera-resistant rootstocks, cultivars and clones, manipulation of carbon production and allocation to advance the onset of ripening, and optimization of fruit composition to improve the commercial viability of the Oregon wine grape industry.

Weeds reduce crop yield and quality and limited options are available for weed control in minor crops. Some weeds are not currently controlled and are causing economic losses. Additional herbicides and management strategies are needed to reduce losses to weed competition. This **Crop and Soil Science** project evaluates new weed management strategies and herbicides for weed control in minor crops including onion, potato, and sugar beet. Studies in weed biology provide insight into developing effective control strategies for difficult weed species.

IMPACT

Project results at the **Southern Oregon Research and Extension Center** have shown that growers and packers can manage postharvest decay in pears more effectively by implementing multiple tactics throughout the production system. New fungicides registered in 2004 will provide control of decay fungi that have developed resistance to previously used compounds, improving overall decay control. Integrated programs combining orchard calcium enrichment, orchard fungicides, and postharvest biocontrol and/or fungicides can provide dependable decay control with very low risk of resistance development in pathogens. Implementation of these tactics can reduce economic loss due to decay and lengthen the potential marketing period through longer storage.

So far, **Botany and Plant Pathology** trials indicate that several cropping sequences have reduced nematode populations by 95% to 100% in three years, even when using popular crops known to be good hosts for root-knot nematodes. Important approaches include the particular order in which crops are grown and the use of green manure cover crops. Enterprise budgets for the different cropping sequences are being constructed to evaluate the economics of these alternative cropping sequences with traditional crop rotation

practices. Some of these innovative approaches may be more profitable as well as more suppressive on damaging nematode populations.

The development and release of superior new potato varieties to PNW (and U.S.) growers and improved management practices developed by the Department of **Crop and Soil Science, Central Oregon Agricultural Research Center** and the **Klamath Experiment Station** will allow PNW growers and processors to remain competitive with foreign producers. Superior varieties can increase production, reduce production costs while at the same time improving water and fertilizer use efficiency and reducing pesticide usage. OSU has released nine varieties during the last decade and has joined neighboring states and the ARS in releasing another dozen. Umatilla Russet has thus far shown the greatest potential of all Oregon releases with more than 40,000 acres in U.S. commercial production (the Tri-state region now produce recently released varieties on over 100,000 acres, at a value to growers placed at $135 million in farm gate value). This improved potato variety yields 21% more U.S. No. Ones that Russet Burbank under approximately the same fertilizer regime, has 10% less hollow heart/brown center than Russet Burbank is is immune to net necrosis, a tuber flesh blemish caused by leafroll virus infection. Seed of Umatilla Russet sells at a $1,00/cwt premium to Russet Burbank. These improvements have resulted in an estimated additional $7.9-9.3 million in farm gate value in recent years. Current Umatilla acreage is worth about $123 million at the farm gate (before processing) and approximately 3 times that value in finished form. Umatilla has generated over $50,000 in royalties from seed sales in 2004. Umatilla is also grown in Canada and various other countries in which North American frozen processing companies operate. Oregon efforts complement extensive multi-state efforts to develop new superior potato varieties and improve cultural management and disease and pest control practices.

In addition**, Crop and Soil Science** potato trials have shown marked differences in resistance to diseases (late blight and viruses), nematodes and physiological disorders. Many clones could be produced commercially without fungicides for late blight, for example, but combining exceptional disease resistance with acceptable quality and yield remains a challenge. Several promising pigmented fleshed selections with anti-oxidant nutritional benefits are gaining interest from processing firms. Results of research at KES suggest control of nematodes and related diseases can be achieved with Vydate at about one-third the cost of current practice using Telone and Vapam in combination. Further, Vydate provided good control of corky ringspot while a combination of Telone and Vapam nearby in the same field was not completely effective. This could lead to greater profitability for growers and reduced pesticide use.

Globally, sustainable forage & livestock systems are a foundational cornerstone of hundreds of millions of acres of crop and grazing lands. This **Crop and Soil Science** DSS project is developing forage crop selection tools that incorporate relevant knowledge from many disciplines to improve decision making. Scientists, educators, and industry personnel from the USA and PRC have cooperated to assemble, analyze, and integrate information on topography, climate, soils, and forage species. GIS-based maps have been created for topography, climate, soils, and species suitability for both countries. Climate and species maps from this project are now recognized as the best available and have been used in scores of agro-climatic applications. Forage species description summaries have been

developed for the seed industry that include quantitative tolerances needed for computer-based mapping. Savings are being incurred in testing programs through better selection of potentially suitable species. Plant breeders are better able to evaluate cost/benefit relationships to guide their research programs. Land managers are better able to select appropriate species for forage, soil conservation, and urban greening projects. Through conferences, workshops, publications, and web-based delivery, project information is being disseminated worldwide. Impact scientifically is better quantitative descriptions of forage species climatic and soil tolerances. Impact for clients is better matching of plants to environmental conditions leading to greater forage production and fewer planting failures.

Nitrogen rate trials generated scientifically valid data useful for regulatory decision-making in the state and provided growers with cost-conserving information. In addition, **Crop and Soil Science** faculty are demonstrating that normal use rates of spring-applied nitrogen on grass seed crops do not leave excessive residual nitrogen in the soil after harvest. Thus, grass seed crops are not subject to nitrogen leaching losses during the winter months in the Willamette Valley under current fertility management. Increasingly, Oregon's annual ryegrass seed growers are managing more acres without open-field burning. Currently, only 23% of this crop acreage is burned. This reduction has been due, in part, to grower confidence in full-straw management options that avoid both smoke from burning and dust from tillage.

Using a custom-designed linear irrigation system, **Crop and Soil Science** faculty were able to establish that spring irrigation economically increases seed yield in two of Oregon's most important grass seed crops, tall fescue and perennial ryegrass. Field trials also demonstrated that trinexapac-ethyl application consistently increased seed yield of creeping red fescue, but was not found to be an alternative practice to field burning, a long-time contributor to air pollution in Oregon.

Horticultural trials showed that there was no cumulative yield advantage to early cropping in berries. The Elliott blueberry variety seems less adapted to high density planting than Bluecrop or Duke. In hardy kiwifruit, growers have more information on what type of fruiting wood to leave after pruning. Canopy density can affect future production in hardy kiwifruit through reduction of light exposure to renewal wood. Thinning may offer some benefits in hardy kiwifruit. A reduction in nitrogen (N) fertilization in strawberry (granular or foliar applications) on an estimated 1,500 acres may save growers about $50,000 to $100,000/year. Red raspberry growers are using specific N fertilizer uptake information to better time applications, thus improving plant productivity. Both fertilizer N studies should have positive impacts through reducing potential for ground water contamination. Aaged sawdust mulch ties up more fertilizer N than fresh sawdust mulch and will result in better N fertilization practices in blueberry production. Obtaining crop coefficients for water use in mature blueberry plants provides vital information for irrigation management.

The release of the thornless blackberry cultivars will alleviate a problem with thorn contamination in machine-harvested thorny cultivars like Marion. New blueberry cultivars from Michigan State University, tested here in Oregon by the **Horticulture** program, will have a large impact on the late-season fresh market and command a premium price. Earlier released cultivars (Lewis, Coho, and Chinook) can enjoy a $0.40 to $0.70/lb premium for the fresh market, an estimated impact of [200 acres planted x 6,000 lb/acre x premium] =

$480,000 to $840,000 per year. Siskiyou had an average $.80 premium/lb and an impact of about $1.9 million.

Some of the new **Horticultural** grape rootstocks showed increased drought tolerance, maintained photosynthesis during the hot summer months, and generated 330% higher yields of similar or higher quality. These new rootstocks have the potential of increasing growers' revenues five-fold while decreasing production costs related to the use of irrigation. Irrigation of mature vines showed that partial rootzone drying was as effective as regulated deficit irrigation in maintaining higher photosynthesis rates and improving vine water status while reducing water input by 50%. This has the potential of reducing production costs and improving fruit quality. In irrigated vineyards, withdrawal from irrigation during color change may improve fruit quality through a rise in ABA in response to drought which in turn enhances translocation of assimilates to the fruit. ABA is synthesized in roots and mature leaves, therefore it is recommended to wait until after veraison for cluster zone leaf removal. Leaf removal at veraison would eliminate sites of ABA production and would decrease carbon partitioning to the fruit. Auxins are synthesized in leaf primordia and young leaves. They increase fruit set and growth but delay the onset of fruit ripening. Removing shoot tips eliminates sites of auxin production and should be done after fruit set but before veraison. In a cool climate growing region such as Oregon, advancing fruit ripening by allocating earlier and more assimilates to the fruit represents a tremendous advantage and may decide the success or failure of the vintage.

Minor crop producers lack herbicides to effectively control weeds. Weeds that are not controlled compete with the crops and cause yields and economic returns. In rangeland, invasive weeds displace native and other desirable vegetation and reduce the capacity to feed cattle and wildlife. **Crop and Soil Science** research continues to identify herbicides and other control measures that are effective and safe for use in specialty crops and in rangeland. Research with dimethenamid-p demonstrated it could be used effectively and safely in onion, potato, and sugar beet. From 2002 to 2004, an emergency exemption label allowed sugar beet producers to use dimethenamid-p with an estimated impact of $23 million per year. Dimethenamid-p recently received a full federal registration for use in onion, potato, and sugar beet and will have additional economic benefits in those crops in production areas throughout U.S. Imazapic is now registered for use in rangelands, and gives land managers another effective tool for reclaiming rangeland infested with noxious weeds. The information gained about the biology of yellow nutsedge under local conditions helps growers understand the level of management that is required to deal with this pest. This information is also being used to educate producers risks associated with this pest in areas where yellow nutsedge is just now becoming established.

Scope of Impact – State, regional, national, and international

Source of Funding - Hatch, State, USDA/CSREES, Oregon Department of Agriculture, Oregon Potato Commission, Agriculture Canada, commodity funds

Key Theme: Precision Agriculture

ISSUE OR PROBLEM

Conventional irrigation practices are designed to prevent crop stress that would reduce crop yield or quality. Optimum irrigation management will require more sophisticated and case-specific analyses of crop water use, crop responses to applied water and all relevant economic factors. This **BioEngineering** project will develop analytical tools and operational procedures to assist farmers optimize irrigation water use. The fundamental goal is to maximize economic yields under a fundamentally different approach to irrigation management.

IMPACT

Initially, this project will provide irrigation managers and those professionals who advise them with a new model for irrigation advisory services predicated on economic objectives. The ultimate impact of this project will be (i) increased farm profitability as net returns to water are increased, (ii) reduced water use, since optimization implies deficit irrigation, and (iii) reduced environmental impacts from irrigation as increasing irrigation efficiency results in reduced leaching of nitrates to ground water and reduced surface water pollution from nutrients, biocides and sediment. The proposed pilot advisory service is expected to provide a model for farmers, consultants and other advisory professionals in the western states. The work will be closely followed by an advisory board made up of professionals in irrigation management from Texas, Colorado and California. It is anticipated that the advisory board members will work on developing parallel projects in their home states to run in parallel with this project. Ultimately this project will be the central subject of a congress of peers at in an international conference on optimum irrigation management. That conference, the last task of the project, is tentatively planned for 2006.

Scope of Impact – State, regional, and national

Source of Funding - Hatch, State

Key Theme: Rangeland/Pasture Management

ISSUE OR PROBLEM

Rangelands are being impacted by a variety of uses and users. Incomplete understanding of both the physical and managerial systems associated with ecological and land use features promote illogical regulation of each. The objective for the Department of **Rangeland** is to determine the most effective land use practices that will result in economic and environmental sustainability of Oregon's ranch lands. Further, a project through the **Eastern Oregon Agricultural Research Center** examines the economic impacts of alternative management and policy options.

IMPACT

Rangeland research results have been used to develop land use plans in eastern Oregon. Through its use state agencies will refine their models of stream heating processes. At the present time a direct relationship between shade and maximum daily water temperature is assumed by the agencies. The selection of the appropriate instrument to measure shade will be refined resulting in better data sets to use in statewide water temperature models. Modified agency models to predict stream temperature are expected to include the results from this research program.

Economic ranch models being developed by **Eastern Oregon Agricultural Research Center** will help predict the overall outcome of a change in management strategy or policy. The economic analysis of improving management of livestock on both upland and riparian areas will help in decisions that result in reduced soil erosion, better water quality, better timing of water flows, and improved wildlife habitat. Improved management practices enhance or help maintain family ranching operations and thereby also better conditions in rural ranching communities. While the research is on-going, faculty are working to identify which practices are profitable and which will require public subsidies in order to be widely implemented. The results can be used in establishing policies to encourage project implementation where public benefits accrue from private investment.

Scope of Impact – State, regional, and national

Source of Funding - Hatch, State, private corporations, U.S. Forest Service, Oregon Department of Fish and Wildlife, Oregon Department of Agriculture, Oregon Department of Environmental Quality, Audubon Society, commodity funds

NATIONAL GOAL #2: A safe and secure food and fiber system. To ensure an adequate food and fiber supply and food safety through improved science-based detection, surveillance, prevention, and education.

OVERVIEW

Oregon Agricultural Experiment Station (OAES) has 21 **projects** with 2 key **themes** under the National Goal #2 in the CRIS database. We selected 7 **projects** from 2 key **themes** to highlight in this year's report. The major selection criteria are the quantifiable outcome and impact. We provide only the summary output data in this section, and will present outcome and impact information under individual key themes below. Review comments from a previous report indicated a redundancy in reporting our outcome and impact statements. Therefore, we have decided not to present the outcome and impact statements in the overview section. Those units which conducted the research with quantifiable impacts are identified within each key theme to encourage our units to write better outcome and impact statements in future years. When appropriate, details of the calculations used to derive the economic impact are presented to substantiate the claim.

Research results have been shared through refereed journal articles, abstracts, books and book chapters; theses, local, regional, national and international meetings, symposia and workshops; GIS climate, geophysical and plant maps; and an array of web pages of an array of types.

- Published 10 **refereed** journal articles, 6 **proceedings** papers, and 12 **abstracts**.
- Made 2 **presentations** at national, international, and professional meetings.

ASSESSMENT:

All units in the Oregon Agricultural Experiment Station are required to conduct annual performance evaluation of their faculty members. These annual reviews are conducted based on goals established during previous year's reviews. Since all faculty members with OAES FTE are required to establish their station projects, annual performance evaluation serves a good vehicle to assess our progress toward the goals in our plan of work. OAES has made good progress in meeting these goals.

Total Expenditures:	$2,118,879
Hatch:	$200,206
Multistate:	$51,011
State:	$1,867,662

TOTAL FTE:	14.7

ACCOUNTABILITY:

Additional information regarding research programs conducted through the Oregon Agricultural Experiment Station may be found in *"Oregon Invests"*, a research accountability database accessible on the web at:

http://oregoninvests.css.orst.edu

There are currently over 346 reports contained in the database, searchable by selected criteria. Each report undergoes systematic professional review with analysis of projected economic, environmental and social effects, as appropriate.

Examples of search topics for Goal 2: fiber, food system, food quality, and food safety

KEY THEMES

Key Themes: Food Quality

ISSUE OR PROBLEM

Improved storage systems and practices are important to keep the U.S. fruit and vegetable industries competitive. Documenting bin placement patterns that will improve air flow distribution uniformity throughout the storeroom will reduce fruit and vegetable quality losses and save energy, thereby increasing profits through this **BioEngineering** project.

To meet the challenges ahead, small to mid-size companies in rural areas dependent upon natural resources must rely on innovation. To achieve this innovation, especially in the area of value-added products, individuals and firms must have access to information, research, and technology. The **Coastal Oregon Marine Experiment Station** will show the feasibility of developing a portfolio of value-added products from fish, e.g., sardines, and shellfish. Several of these products will use High Pressure Processing as a means of extending the shelf-life of the product.

The **Coastal Oregon Marine Experiment Station** will also incorporate on-going innovative research regarding new technologies and product diversification into a community-based delivery model resulting in increased economic impact on rural and distressed coastal communities in Oregon and Washington. This effort will bring university research and science closer to the community and individual business level, thereby involving communities in rebuilding their economy and protecting their natural resources.

Northwest food and agricultural industries need to gauge success and acceptance for new and modified food products with a diverse consumer population. This **Food Innovation Center** project establishes a database of diverse consumers to taste test new food products, which will assist food processors to identify consumer segments that like and consume their products. Relating consumer lifestyle to their food preferences will help gauge the target populations for new foods.

The **Department of Food Science & Technology** is examining a number of issues within the wine industry. One effort examines the influence of grape and wine production

practices on tannin and color development as it is unclear how the astringency and color of red wines can be managed consistently. Another effort examines the effect of grape nutritional status on the production of off flavors since Oregon wines can have problems with off aromas due to problem fermentations. A final effort examines the style of wine produced from different varieties of grapes as new grape growing regions are put into production in Oregon.

IMPACT

The financial impact of **BioEngineering** findings can sometimes difficult to assess. However, as fruit quality decreases, so does attainable price. Lowering the grade of fruit one or two levels may drop prices to where the profit margin has been eliminated. These findings will help operators reduce losses in fruit and vegetable quality during storage.

The **Coastal Oregon Marine Experiment Station** sardine research has created interest from area processors who are looking for alternative markets for their sardines. Currently, the majority of the sardines are being sold to the Asian market for bait used in other fisheries (e.g. tuna). By producing value-added nutraceuticals, the seafood industry could diversify their markets and open new avenues of revenue. The cold-press method used to recover fish oil will lessen the degree of oxidation in the final product that results from the traditional heat-press method used by industry. The local sardine industry is growing, and there are currently seven companies harvesting about 50 million lbs per year. Another product developed is a new form of salmon jerky that has an extended shelf-life and is similar in sensory properties to the original product; a local company expects to put this product into production next year.

There has been considerable effort by the albacore industry to improve the onboard handling methods for their fisheries. This has led to increased ex-vessel price for fishermen that land high quality fish. Several local producers have also begun marking their products with traceability information to better inform their customers about the fisheries and their product. The results from the program's mercury study have greatly improved the marketability of troll-caught tuna from the West Coast of the U.S. Several fishermen and processors (mainly canners) have used the information from **Coastal Oregon Marine Experiment Station** research to market their product and differentiate their tuna from national brands. This has created a significant demand for local caught albacore in both the frozen state and canned product and has resulted in a significant increase in the ex-vessel price to the fishermen as well as an increased demand for troll-caught canned albacore tuna.

The demand for value-added products is rising, but U.S. processors face the challenge of creating value-added products in the seafood and wine sectors that consumers find healthful and tasty. There is product expansion potential for juvenile albacore tuna that is abundant in the Northern Pacific Ocean, high in omega-3 fatty acids with many health benefits, and lower in mercury; a **Food Innovation Center** (FIC) study showed that consumers respond favorably to omega-3 health benefit information, preferred familiar seasonings and cooking methods for tuna compared to novel ones. Thus, educating the public about the health benefits of fish high in omega-3 and low levels of mercury would support the industry for juvenile albacore tuna value-added products. The wine industry faces significant product spoilage from natural cork taint, but it is also challenged with

consumer acceptance of natural cork alternatives, such as synthetic corks and screw caps. A FIC study showed that consumers could not tell the difference between wines bottled with different closures based on taste alone. However, when they knew the wine was sealed with a screw cap, they considered it of lower quality, were less willing to buy it and would pay less. If they knew the wine was sealed with a natural cork, it was rated as higher quality and they would pay more for the wine. Since the wine industry is using the new closures more, especially screw cap, the need for consumer education on the positive benefits of alternative closures and negative aspects of natural corks is increasingly important.

The wine industry is becoming increasingly competitive nationally and internationally. To increase Oregon's competitive advantage globally, the quality of its wine needs to continue to improve while reducing its cost of production. Working with national and international collaborators, the Department of **Food Science & Technology** has made significant inroads into red wine color stability and astringency quality improvement. It also has made significant progress towards developing a means to manage red wine style in the vineyard by applying precision agriculture tools.

Scope of Impact – State, regional, national, and international

Source of Funding - Hatch, State, USDA, Oregon Economic Development Department, U.S. Economic Development Agency, Oregon Department of Agriculture, National Marine Fisheries Service, Agricultural Research Foundation, National Science Foundation, commodity funds

Key Themes: Food Safety

ISSUE OR PROBLEM

The food industry continually seeks methods of food preservation that result in improved safety and/or quality. However, acceptance of a new technology is dependent upon accurate and reproducible predictions of its efficacy. This **Food Science & Technology** project examines the rate of chemical, biochemical and microbial changes that ultimately determines the length of quality or the margin of safety in our foods processed using novel techniques.

A second **Food Science & Technology** project will enhance and ensure the safety of PNW fresh and processed berries through integrated research, education and Extension efforts. At times fresh Northwest berries and their juices and purees have challenged the belief that high acid foods cannot harbor viable pathogenic bacteria. They could also act as a vector for foodborne illness.

IMPACT

Research on the efficacy of emerging technologies against foodborne pathogens and spoilage organisms is vital to understanding the feasibility of these technologies in food processing. Microbial tolerance to lethal treatments with existing as well as new processing technologies is strongly dependent on environmental pH. High hydrostatic pressures can lead to greater protonic ionization in certain buffer systems which result in a temporary

decrease in pH under pressure. The underlying principal in the project work is that the significant pressure dependency of some buffer systems results in the temporary production of hydrogen ions at pressure and produces a larger acid x pressure interaction relative to that from a fully ionized acid that is insensitive to pressure. This pressure sensitivity may be manipulated to increase the lethality of high pressure processing. The project has demonstrated that significant differences in lethality exist between pressure sensitive and pressure insensitive buffers. At low pH the pressure sensitive buffers (citric and phosphoric acids) were more lethal than pressure insensitive (ethanesulfonic acid) buffers. At neutral pH, the pressure sensitivity was not as apparent as it was at lower pH levels. Pressure-induced pH shifting of buffered systems may be manipulated to increase the lethality of chemical antimicrobials in pressure processed foods. With increased lethality, high pressure processing may find a broader range of industrially-suitable applications for food preservation without the use of heat.

Efforts to increase the understanding of the microbial safety of Northwest berry fruits, to assist the berry growers and processors develop high quality and safety products, and to educate college students in food safety and sanitation are critical to public health and regional agriculture and industry. Workshop participants reported that the training enhanced their understanding on the importance of SSOPs and HACCPs, and improved their knowledge in developing HACCP plans.

Scope of Impact – State, regional, national, and international

Source of Funding - Hatch, State, USDA, private corporations

NATIONAL GOAL #3: A healthy, well-nourished population. Through research and education on nutrition and development of more nutritious foods, enable people to make health promoting choices.

OVERVIEW

Oregon Agricultural Experiment Station (OAES) has 11 **projects** with 2 key **themes** under the National Goal #3 in the CRIS database. We selected 5 **projects** from 1 key **theme** to highlight in this year's report. The major selection criteria are the quantifiable outcome and impact. We provide only the summary output data in this section, and will present outcome and impact information under individual key themes below. Review comments from a previous report indicated a redundancy in reporting our outcome and impact statements. Therefore, we have decided not to present the outcome and impact statements in the overview section. Those units which conducted the research with quantifiable impacts are identified within each key theme to encourage our units to write better outcome and impact statements in future years. When appropriate, details of the calculations used to derive the economic impact are presented to substantiate the claim.

Research results have been shared through refereed journal articles, abstracts, books and book chapters; theses, local, regional, national and international meetings, symposia and workshops; GIS climate, geophysical and plant maps; and an array of web pages of an array of types.

- Published 12 **refereed** journal articles, 1 **book**, and 1 **proceeding** paper.

ASSESSMENT:

All units in the Oregon Agricultural Experiment Station are required to conduct annual performance evaluation of their faculty members. These annual reviews are conducted based on goals established during previous year's reviews. Since all faculty members with OAES FTE are required to establish their station projects, annual performance evaluation serves a good vehicle to assess our progress toward the goals in our plan of work. OAES has made good progress in meeting these goals.

TOTAL EXPENDITURES:	$635,209
Hatch:	$67,193
Multistate:	$48,085
State:	$519,931

TOTAL FTE:	6.4

ACCOUNTABILITY:

Additional information regarding research programs conducted through the Oregon Agricultural Experiment Station may be found in *"Oregon Invests"*, a research accountability database accessible on the web at:

http://oregoninvests.css.orst.edu

There are currently over 346 reports contained in the database, searchable by selected criteria. Each report undergoes systematic professional review with analysis of projected economic, environmental and social effects, as appropriate.

Examples of search topics for Goal 3: human health, and human nutrition.

KEY THEMES

Key Themes: Human Health

ISSUE OR PROBLEM

Each year 500,000 persons in the United States die from cancer. Although epidemiologists have linked one/third of these deaths to dietary imbalances, the specific factors in our foods that may provide protection against this disease, or increase the risk of developing the disease, are not well understood. The Department of **Environmental and Molecular Toxicology** will examine the dose-response efficacy and molecular mechanisms by which three classes of food-borne phytochemicals -- indoles, chlorophylls, tea antioxidants -- protect against cancer in experimental animals and humans.

Humans are often exposed to various chemicals, such as a) polycyclic aromatic hydrocarbons (PAH) in various mixtures including diesel exhaust and urban air and b) pesticides. The Department of **Environmental and Molecular Toxicology** is working to assess risks and inform stakeholders about chemical exposure. One effort is the development of a rapid assay for DNA-binding of PAH to assess the relative risk these complex mixtures pose to humans, as some PAHs are very potent carcinogens in rodents and some mixtures such as coal tar are known to cause cancer in humans. The Department has also identified a need to produce specialized medical and toxicological informational relating to pesticide exposures by health care providers, regulatory officials, and the general public.

DNA mismatch repair deficiencies contribute to both familial and non-familial cancer development, indicating that mismatch repair functions protect against cancer. The Department of **Environmental and Molecular Toxicology** will elucidate the mechanisms and importance of different DNA mismatch repair functions in the prevention of cancer.

Anthocyanin pigments and polyphenolics provide several health benefits because of their antioxidant properties, but compositional information on their concentrations, distribution, and antioxidant properties is needed. The Department of **Food Science & Technology's** proposes to identify and measure the anthocyanin pigments and polyphenolics in fruit and vegetable processing wastes and potential new crops.

IMPACT

Research in the past 20 years has revealed a strong link between dietary factors and risk of cancer. The links may be positive, where some factors increase cancer risk, or negative, for factors that may protect against cancer. In the past year this **Environmental and Molecular Toxicology** project has confirmed that I3C and DIM, both now in clinical trials and available as health food supplements, are double edged swords that not only protect in some models but enhance in others. The most recent results suggest that these agents can promote liver cancer through estrogenic mechanisms in trout and rats. The significance of this mechanism now needs to be explored in human liver. The project has previously found that the food dye chlorophyllin suppressed human liver cancer risk indicators in China by over 50%, and might save as many as 5% of the population in endemic regions from death by this major killer. Recent project results offer evidence that this protection may extend to natural chlorophyll as found in green and leafy vegetables. Clearly the continued identification of such simple dietary factors that protect against a variety of cancers has great potential to reduce human suffering and medical costs in Oregon, the U.S., and worldwide.

The Department of **Environmental and Molecular Toxicology** is developing a short-term marker for assessing the environmental risk that exposure to PAH-containing environmental mixtures. The work focuses on three important complex mixtures such as coal tar, diesel exhaust or urban dust and the danger they pose to humans by measuring their ability to induce DNA damage and tumor formation in mouse skin and human cells in tissue culture. Cancer in humans causes a huge social and economical toll. Therefore, finding the causes for cancer and establishing methods to evaluate the risk environmental mixtures pose to humans could provide tremendous benefit to the citizens of Oregon and the rest of the United States. During the past year the researchers have found that a DNA damage assay in the blood cells of mice appears to be an excellent predictor of the cancer induction risk of the mixture such as urban dust.

The Department of **Environmental and Molecular Toxicology** has delivered information on many pesticide topics through various media and venues. For example, in the past year over 209 copies of the National Pesticide Medical Monitoring Program (NPMMP**)** 2003 annual report were downloaded from the NPMMP website. Additionally, electronic presentations describing the NPMMP and presenting electronic resources on pesticide toxicology for health care providers have been downloaded over 181 times since their deployment on the NPMMP website. The NPMMP faculty have been invited presenters at the Oregon Department of Health Services Public Health Grand Rounds, and have delivered a presentation on electronic resources on pesticides for public health professionals. The presentation described an investigation of health effects among agricultural workers and the presentation was videotaped by the Oregon Department of Health Services for distribution to public health departments throughout the state of Oregon. In the past year, the NPMMP was also an invited presenter at regional and national meetings of the Northwest Association of Occupational and Environmental Medicine, the Agency for Toxic Substances and Diseases Registry, and the American College of Occupational and Environmental Medicine. The NPMMP electronic library currently maintains over 625 indexed technical reports and

peer-reviewed publications on the clinical toxicology of pesticides. These publications are readily accessible and can be electronically transmitted in response to inquiries. As a result of a competitive proposal, the NPMMP at Oregon State University has received a 5-year renewal for continuing activities from the U.S. EPA Office of Pesticide Programs.

Cancer development requires a series of alterations (mutations) in cellular DNA. People are protected against cancer by numerous cellular pathways that prevent the accumulation of mutations or that signal the death of damaged cells that otherwise might become a cancer. A thorough understanding of the biochemistry of such pathways is critical for the development of effective therapeutic and preventative strategies for dealing with cancer in human populations. By determining the biochemical consequences of mutations affecting a DNA repair pathway commonly inactivated in human cancer (DNA mismatch repair), **Environmental and Molecular Toxicology** researchers will elucidate how a developing cancer cell is able to subvert protective cellular functions. To this end, cellular and biochemical assays are being developed and validated that can be used to measure the consequences of specific mutations in the human mismatch repair gene, MLH1. At the present time, one novel assay has been developed and applied to several mutations in MLH1, and current results indicate that the new approach is superior to previously published analyses.

Food processors and nutritionists are interested in developing fruit and vegetable varieties that contain higher amounts of dietary antioxidants, in addition to other desirable quality attributes and horticultural properties. Working with plant breeders, the Department of **Food Science & Technology** has analyzed the anthocyanin pigment, polyphenolic composition, and antioxidant properties of new selections of several fruits and vegetables. Some of the experimental blackberry selections were higher in total anthocyanins and total phenolics than the common commercial varieties, showing the potential for obtaining new cultivars with high pigment/phenolic content through classical plant breeding. The development of potatoes with red and purple flesh pigmentation offers the possibility of new product line extensions, in addition to having potatoes with higher levels of dietary antioxidants. One Oregon-based company has purchased exclusive rights to a red-fleshed potato that is being used for potato chips that are burgundy-colored and also have high levels of dietary antioxidants. Departmental faculty are working collaboratively with horticulturists to evaluate plant materials that have potential for being new commercial crops in the PNW. Analysis of PNW huckleberries collected from the wild and grown in cultivated plots show that the fruits are very rich in anthocyanin pigments and dietary antioxidants.

Scope of Impact – State, regional, national, and international

Source of Funding - Hatch, State, National Institutes of Health, Linus Pauling Institute, Environmental Protection Agency, USDA/CSREES, National Research Initiative

NATIONAL GOAL #4: Greater harmony between agriculture and the environment.

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

OVERVIEW

Oregon Agricultural Experiment Station (OAES) has 52 **projects** with 15 key **themes** under the National Goal #4 in the CRIS database. We selected 14 **projects** from 7 key **themes** to highlight in this year's report. The major selection criteria are the quantifiable outcome and impact. We provide only the summary output data in this section, and will present outcome and impact information under individual key themes below. Review comments from a previous report indicated a redundancy in reporting our outcome and impact statements. Therefore, we have decided not to present the outcome and impact statements in the overview section. Those units which conducted the research with quantifiable impacts are identified within each key theme to encourage our units to write better outcome and impact statements in future years. When appropriate, details of the calculations used to derive the economic impact are presented to substantiate the claim.

Research results have been shared through refereed journal articles, abstracts, books and book chapters; theses, local, regional, national and international meetings, symposia and workshops; GIS climate, geophysical and plant maps; and an array of web pages of an array of types.

- Published 102 **refereed** journal articles, and 3 **proceedings** papers.

ASSESSMENT:

All units in the Oregon Agricultural Experiment Station are required to conduct annual performance evaluation of their faculty members. These annual reviews are conducted based on goals established during previous year's reviews. Since all faculty members with OAES FTE are required to establish their station projects, annual performance evaluation serves a good vehicle to assess our progress toward the goals in our plan of work. OAES has made good progress in meeting these goals.

TOTAL EXPENDITURES:	$5,070,990
Hatch:	$315,268
Multistate:	$205,247
State:	$4,550,475

TOTAL FTE:	47.3

ACCOUNTABILITY:

Additional information regarding research programs conducted through the Oregon Agricultural Experiment Station may be found in *"Oregon Invests"*, a research accountability database accessible on the web at:

http://oregoninvests.css.orst.edu

There are currently over 346 reports contained in the database, searchable by selected criteria. Each report undergoes systematic professional review with analysis of projected economic, environmental and social effects, as appropriate.

Examples of search topics for Goal 4: environment, waste management, biological control, biodiversity, endangered species, forest resources, climate change, integrated pest management, soil quality, sustainable agriculture, wildfire, and water quality.

Key Themes: Hazardous Materials

ISSUE OR PROBLEM

Tetrachlorodibenzodioxin (TCDD) and related compounds are persistent environmental contaminates which are known to cause a plethora of effects in diverse vertebrate classes. Currently we do not know how these chemicals lead to toxicity. This project is designed to determine the mechanism by which TCDD leads to specific toxicity.

IMPACT

Results obtained by the Department of **Environmental and Molecular Toxicology** have the potential to significantly impact the field of PAH environmental toxicity. Elucidating the mechanism of PAH action, and dissecting the interactions between the well-conserved aryl hydrocarbon receptor and the tissue remodeling pathways may explain a number of the diverse PAH responses observed in mammals and wildlife. For instance, the most sensitive response following TCDD exposure appears to be the developing male and female reproductive systems. The project model and data may provide a mechanistic explanation for the documented phenomena that could be confirmed in the more technically challenging mammalian systems. Therefore, this data could provide key data and be part of the equation for rational PAH developmental risk assessment.

Scope of Impact – State, regional, national, and international

Source of Funding - Hatch, State, National Research Initiative

Key Themes: Integrated Pest Management

ISSUE OR PROBLEM

Grass seed and rotational crops are affected by diverse pests due to changes in production practices as a result of the phase out of burning and the inadvertent introduction of new pests to the area. The purpose of this **Crop and Soil Science/Entomology** program was to determine the pests associated with grass seed and rotational crops in Oregon, evaluate their impact and develop appropriate IPM strategies for their control.

Pears, apples and sweet cherries accounted for a total value of $129,176,000 (averaged over the last three years) of Oregon's agricultural economy. Economically viable production of pears, apples and cherries depends on annual control programs to prevent unacceptable pest damage. This **Mid-Columbia Agricultural Research and Extension Center** project investigates selective pest management as a sustainable alternative to conventional pest control on tree fruits with broad-spectrum pesticides.

Managing pests in a cost-effective and environmentally friendly manner is an important component of a profitable and sustainable tree fruit industry in Oregon. The goal of this research at **Southern Oregon Research and Extension Center** is to develop and implement an integrated pest management program in tree fruit, which minimizes the use of disruptive, broad-spectrum pesticides and maximizes the benefits of naturally occurring biological control agents through the use of selective pest management techniques.

IMPACT

Several activities through **Crop and Soil Science/Entomology** benefited Oregon and regional growers and the public. Bent grass growers *w*ere unaware that a new pest, *Chirothrips manicatus,* was destroying seeds. It develops completely within the seed and consequently has considerable direct impact on yield. The information provided by the department enabled growers to initiate sampling procedures for detection of the pest and application of control measures for its management. A mitochondria cytB marker that was identified can separate the two exotic crane fly species from each other and from natives. The DNA extraction and sequencing costs less than $20 (US) per sample, which is considerably less than the cost to rear a single individual crane fly larva. With the molecular marker, growers can get their samples identified in a week as compared to the year required for rearing. These enhancements facilitate decisions on application of control measures. A departmental study also documented that detection procedures for cereal leaf beetle needed to be initiated in late summer. If the pest is present in new stands of grasses, management techniques are needed to reduce loss of the new stands. Through the department’s Rural Science Education Program, over 50 new hands-on inquiry-based science activities were developed and implemented in 57 Oregon K-12 classrooms in two years. These included short and long term activities related to entomology and other life science and agriculture based disciplines. A case study indicated that 6.7 % rural middle school students found that science was more exciting at year-end compared to the beginning. 'Before' and 'after' science content quizzes indicated a 29% increase in scores.

The **Mid-Columbia Agricultural Research and Extension Center** project is helping growers steadily move towards safer, more environmentally friendly and more selective pest control tactics and replace traditional broad-spectrum chemical controls with

selective options including non-OP insecticides, mating disruption techniques and biological controls. These changes will mean reduced incidences of toxic chemical drift and runoff to water sources and less farm worker exposure to broad-spectrum neurotoxic chemicals, especially organophosphate insecticides. Without effective pest control based on recommendations from this project, the Mid-Columbia apple, Bartlett, winter pear and cherry crops would be worth much less due to unacceptable pest damage to trees and fruit and even complete crop loss. A conservative estimate of the economic benefits to northern Oregon fruit growers from this project is one-tenth of the total $67 million annual average sales value of pears, apples and cherries.

Adoption of IPM technologies in southern Oregon orchards, when done correctly, has been shown to result in reduced pesticide use while maintaining high standards of fruit quality. Based upon findings by the **Southern Oregon Research and Extension Center**, approximately 40% of the local tree fruit acreage (3,000 acres) is currently utilizing mating disruption based IPM programs with minimal use of problem insecticides (e.g. organophosphates, carbamates, pyrethroids), with at least one-third of the acreage using no organophosphates or carbamates in 2004. An additional 50% of the tree fruit acreage (3,600 acres) monitor pest populations and use weather data and phenology models to predict pest development; together these data are used to reduce the number of unnecessary pesticide applications. Access to these weather data and phenology models has been facilitated by the Pest Alert web page, which has had over 20,000 hits. During 2004, over 50 acres of orchards were in the process of transitioning to organic fruit production, utilizing organically approved pest management tactics such as mating disruption, codling moth granulosis virus and kaolin particle films, which were first tested locally at the Research Center. Growers representing two-thirds of the tree fruit acreage attend the biweekly pest management forums offered by the Southern Oregon Research and Extension Center and discuss monitoring methods and results, and use this information to modify and improve their pest management programs.

Scope of Impact - Scope of Impact – State, regional, and national

Source of Funding - Hatch, State, Agricultural Research Foundation, USDA, commodity funds

Key Themes: Natural Resource Management

ISSUE OR PROBLEM

Agriculture, forestry and other land management industries require more precise and accurate spatial assessments of soil and land resources in order to operate at efficient and competitive levels. The Department of **Crop and Soil Science will** develop efficient new means of assessing soil-landscape evolution and mapping soil resources in Oregon that are accurate and present accessible data for the demands of precision agriculture and forestry. Potential soil maps will be explored as a concept and as a point of validation for global change models.

IMPACT

Proposed research activities will focus on the soils of the Willamette Valley and the Cascade Range, Oregon, and will involve integrated field and laboratory tasks designed to collect, analyze and report data and interpretations. Available environmental data will be used to develop and validate soil-landscape models. Spatial-temporal analyses of resulting soil maps, as well as statistical treatments of all other data sets are (re)considered in the data analysis task. Once a model(s) is(are) selected, a soil potential map will be created and evaluated. In 2004, advances in methodology were made and key regional and national collaborations established. A regional field trip was conducted for the annual meeting of the Soil Science Society of America. One of the new regional approaches to mapping soil resources was displayed to leading national and international soil scientists, providing an important opportunity for field review of concepts being advanced by this project. New regional soil resource assessment projects established in 2004 with several Federal agencies is an important step towards realizing effective soil-resource management in PNW forests, parks and other public lands.

Scope of Impact – State, regional, and national

Source of Funding - Hatch, State, EPA, local government agencies

Key Themes: Nutrient Management

ISSUE OR PROBLEM

Certain agricultural practices contribute to the problem of nitrate in water. This **Botany and Plant Pathology** project examines the basic underpinnings of the microbial processes involved in nitrate production. It will investigate the expression of genes and the nature of the enzymes required for the oxidation of ammonia (NH_3) by nitrifying bacteria, focusing on the well-characterized nitrifying bacterium *Nitrosomonas europaea*. The reactions carried out by nitrifying microorganisms are critical to the fate of NH_3 and urea applied to croplands and the subsequent impact of these fertilizers on the environment.

Byproducts from farms, industry, and cities have nutrient value for crop production, but careful management practices are needed to protect environmental quality. The Department of **Crop and Soil Science** will develop guidelines for appropriate utilization of byproducts to protect environmental quality and to provide economical alternatives to landfill disposal or incineration.

IMPACT

Worldwide, about 8×10^{13} g of industrially-produced nitrogen (N) are applied to croplands annually. Fertilizer N production, primarily as NH_3, requires large inputs of natural gas and H_2. In croplands fertilized with ammonia-based fertilizers, ammonia oxidizers contribute to the mobilization of this N by the production of NO_2-, which is rapidly converted to NO_3- by nitrite-oxidizing bacteria. NO_3- is readily leached from these soils into ground waters (often to levels rendering the water unfit for human consumption) and surface waters (contributing to their eutrophication). Furthermore, NO_3- is a substrate

for denitrification, resulting in the conversion of this plant-available N to N_2 and a waste of the energy initially used to produce the NH_3. In contrast, ammonia oxidizers are beneficial in the treatment of wastewaters and they show potential for bioremediation of soils contaminated with chlorinated aliphatic hydrocarbons. Mitigation of the negative effects and exploitation of the beneficial effects of ammonia oxidizers will be facilitated by a thorough understanding of their metabolism. The attempt by **Botany and Plant Pathology** to grow *N. europaea* on organic compounds was successful, now new possibilities are possible for mutational analysis of NH_3 catabolism (e.g. site-directed mutagenesis of AMO). While the focus is on *N. europaea*, it is expected that the results will extend to other ammonia oxidizers.

Land application of yard trimmings from urban landscapes on farmland is an emerging recycling alternative in the PNW. **Crop and Soil Science** determined the typical amounts of plant-available nitrogen provided by yard trimmings, and the information has been incorporated into Extension guidance for the states of Oregon and Washington. The use of yard trimmings as a soil amendment and nitrogen source is of particular interest to farmers interested in non-chemical sources of nitrogen for crop production.

The project also developed a quick and reliable method for the measurement of compost stability. The method is suitable for on-site use by compost facility operators with minimal training or scientific expertise, with test results available in four hours. The method uses a large sample size, thereby minimizing problems with collection of a representative sample. The cost per test is less than $10. A collaboration with the Oregon Department of Environmental Quality (ODEQ) to evaluate the stability quick test method in a pilot food-waste composting project showed that this method was suitable as a replacement for the standard laboratory stability test method. ODEQ is in the process of revising its composting regulations, including stability test requirements. The compost stability test method also shows promise in helping organic farmers comply with requirements of recently adopted USDA National Organic Program.

Scope of Impact – State, regional, and national

Source of Funding - Hatch, State, Agricultural Research Foundation, USDA, National Research Initiative, National Science Foundation, Oregon Department of Energy

Key Themes: Soil Quality

ISSUE OR PROBLEM

Hydrologic and water resources modeling is performed at the catchment or regional scale while soil hydraulic processes controlling infiltration and evaporation are typically measured at the local, i.e. point, scale. The Department of **BioEngineering** examined existing soils databases developed by project cooperators to parameterize infiltration and evaporative fluxes at scales compatible with hydrologic modeling.

Many wells contain trace pesticides and excessive nitrate. This **BioEngineering** project investigated which practices are contributing to these problems and what practices might reduce these impacts.

Mechanisms controlling carbon storage in, and release from, soils could affect future environmental health. Carbon storage in PNW soils may partially offset regional CO_2 emissions. The Department of **Crop and Soil Science** quantified soil carbon storage and predicted conditions under which carbon storage is maximized and those under which storage no longer occurs.

IMPACT

Data collection and analysis by **BioEngineering** have continued for a NASA-JPL (Jet Propulsion Lab) project in soil profile monitoring sites near Sisters, OR. Data from this site are to be used to calibrate and develop a prototype remote sensing system for soil moisture content using dual polarity active radar. The simultaneous soil profile monitoring of soil water content, soil water potential and soil temperature were reported at the Soil Science Society of America meeting in Seattle (Cuenca, et al., 2004). The procedure and instrumentation employed led to very large data sets for development of *in situ* soil water retention functions. The long-term soil moisture and precipitation data set (multiple years) has led to potential development of algorithms for persistence of seasonal precipitation on subsequent evapotranspiration. One of the aspects of the data set brought forward in the Seattle meeting was the inability of current procedures to adequately correct for temperature effects on the dielectric constant in a soil-water matrix. This temperature effect varies as a function of soil moisture content which affects the proportion of water molecules tightly bound to the soil surface compared to free water within the soil pore space. The long-term data allow for investigation of various algorithms for the temperature correction since both wet and dry periods are represented. JPL ran the prototype dual polarity sensor system at the Sisters site this year and are currently carrying out data analysis. Once developed and tested, the system is to be deployed by satellite.

The farmers of Oregon are responsive to **BioEngineering** research findings that improve the management of their soil, water, and nutrient resources to provide full yield and protect the quality of groundwater. In 2004 the southern Willamette Valley was named a Ground Water Management Area (GWMA) by the Oregon Department of Environmental Quality following years of study and public outreach. This action marks a new investment by the state and public in the resolution of a problem which the department has long advocated. In the coming years the data we have gathered will provide a solid and constructive foundation upon which the community will build a response. At the Yucca Mountain site departmental analysis of the flow paths of water in the mountain will be influential in the final waste isolation design adopted. Colloidal transport is a primary mechanism for movement of hazardous chemicals to groundwater resources. The department's novel imaging techniques have been adopted by other laboratories, and these methods will be very important to the validation of models for colloidal movement. In the long term, these techniques should be critical to the development of remediation methodologies.

Oregon forests store a tremendous amount of carbon in both aboveground biomass and belowground pools (roots, soil organic matter). Both field and modeling studies by **Crop and Soil Science** have suggested changes in temperature and moisture regimes could have a dramatic impact on the amount of carbon stored in soils or released to the atmosphere, with potential feedbacks to regional and global climate. Measurements of soil respiration, moisture, and temperature from experimental plots within the H.J. Andrews Experimental Forest, central Cascades, Oregon, recorded between June 2001 and November 2003 were used to determine: (1) the proportion of soil CO_2 efflux that is sensitive to factors that may alter future carbon storage, (2) the likely response of Oregon's soil carbon stores to future climate scenarios, and (3) the likely response of Oregon's soil carbon stores to future atmospheric CO_2 levels. The data suggest: (1) roughly 75% of CO_2 released from the studied soils may affect future carbon storage, (2) if Oregon's future climate is wetter during the period with warm soil temperatures, soil CO_2 efflux could increase dramatically, acting as a positive feedback on climate, and (3) future increases in atmospheric CO_2 are likely to lead to decreased, rather than increased, carbon storage in Oregon's soils.

Scope of Impact – State, regional, and national

Source of Funding -Hatch, State, National Science Foundation, National Aeronautic and Space Administration, U.S. Department of Energy, Oregon Department of Environmental Quality, Oregon Department of Agriculture, Agricultural Research Foundation

Key Themes: Water Quality

ISSUE OR PROBLEM

Research by the Department of **Agricultural and Resource Economics** will focus on helping Oregon farmers improve their water management. In particular, they will seek ways to profitably reduce on farm irrigation use using deficit irrigation. Irrigation water is becoming an increasingly scarce resource as non-agricultural uses increase in importance, in particular in-stream uses to restore aquatic ecosystems.

Direct seed farming and production of high end use quality wheats are important practices that will keep Oregon dryland farms profitable. The **Columbia Basin Agricultural Research Center** is examining direct seed farming practices and nutrient management strategies to test and develop conservation farming practices that protect soil health and water quality, improve wheat end use quality, and maintain or enhance current wheat markets.

State-and-Transition models hold great potential in understanding rangeland ecosystems' response to natural and/or management-induced disturbances. However, research data to support the conceptual model is lacking. This **Rangeland** project examines the accuracy and precision of state-and-transition models, developed for a variety of ecological sites, in predicting response to disturbance on the basis of ecological function.

IMPACT

Agricultural and Resource Economics faculty have worked with various stakeholders to develop acceptable solutions that address the water and habitat problems in several river basins in Oregon, including the Grande Ronde and Upper Klamath. The output from these efforts have been helpful in developing long-term management options for water management agencies, fish and wildlife agencies, and agricultural interests. For example, the National Research Council's Klamath report has been cited by agencies as the basis for the development of a water bank in the Klamath basin in 2002.

Direct seeding of winter and spring cereals varies between 10 and 80% of cropland acres in counties in eastern Oregon and Washington. Information from direct seeded wheat and nitrogen management is helping growers refine fertility rates and apply the appropriate amount of nitrogen, phosphorus and sulfur. Furthermore, the **Columbia Basin Agricultural Research Center's** canola research has enable growers to direct seed into chemical fallow and produce acceptable stands and consistent yields. Growers have pooled funds and sought grant money to form an LLC to market value added products from canola. A business plan is being prepared for the LLC.

The 2003 **Rangeland** publication, "State and transition modeling: An ecological process approach," has revolutionized ecological theory and management model development for rangelands of the United States. The Natural Resource Conservation Service (NRCS) is utilizing this model in their Grazing and Pastureland Handbook that guides management planning on the private rangelands of the United States. In addition, the completion of the landscape-scale development of state-and-transition models project promises to improve scientists' ability to predict change over large landscapes. Three publications are currently in development. Furthermore, NRCS has contracted with OSU Rangeland Resources for development of state-and-transition models for Oregon's rangelands over the next 15 months that will improve NRCS's ability to assist landowners in making appropriate land management decisions. At the present time, no models have been developed for Oregon and professionals are making decisions based on old knowledge. The models will improve management's ability to make cost effective decisions on large rangeland landscapes.

Scope of Impact – State, regional, and national

Source of Funding - Hatch, State, Oregon Farm Bureau, Environmental Protection Agency, National Institute of Environmental Health Sciences, Oregon Department of Environmental Quality, Oregon Health Division, Soil and Water Conservation Districts, local government agencies, private corporations

Key Themes: Wetlands Restoration & Protection

ISSUE OR PROBLEM

The loss of wetlands throughout the United States has created challenges for conserving and managing for migratory wetland birds. A suite of **Fisheries & Wildlife**

projects focus on understanding the value of wetlands on public vs. private lands for migratory birds as well as ways to manage refuges for non-breeding waterbirds.

IMPACT

The continued loss of wetland habitat in the United States has made it increasingly difficult to conserve migratory waterbirds. Departmental research contributes to understanding the ecology of wetland birds and ways to manage lands or apply policy to achieve conservation objectives. Working with scientists in the U.S. Fisheries & Wildlife Service and Ducks Unlimited, the department is developing a conservation planning tool that incorporates data on food availability in specific wetland habitats, bird population objectives, and water requirements in different habitat types to model different management scenarios under varying water delivery levels. Early results found significantly different food availability in seasonal vs. permanent wetlands. The total water requirements to produce an acre of each habitat type are similar, but the timing of water needs differs. Together with a recently completed analysis of temporal patterns in waterfowl survey data, these results will allow refuge managers to model realistic water delivery schedules to maximize their use of a limited resource, water.

Scope of Impact – Regional and national

Source of Funding - Hatch, State, U.S. Fish and Wildlife Service

NATIONAL GOAL #5: Enhanced economic opportunity and quality of life for Americans. Empower people and communities, through research-based information and education, to address economic and social challenges facing our youth, families, and communities.

OVERVIEW

Oregon Agricultural Experiment Station (OAES) has 10 **projects** with 5 key **themes** under the National Goal #5 in the CRIS database. We selected 3 **projects** from 3 key **themes** to highlight in this year's report. The major selection criteria are the quantifiable outcome and impact. We provide only the summary output data in this section, and will present outcome and impact information under individual key themes below. Review comments from a previous report indicated a redundancy in reporting our outcome and impact statements. Therefore, we have decided not to present the outcome and impact statements in the overview section. Those units which conducted the research with quantifiable impacts are identified within each key theme to encourage our units to write better outcome and impact statements in future years. When appropriate, details of the calculations used to derive the economic impact are presented to substantiate the claim.

Research results have been shared through refereed journal articles, abstracts, books and book chapters; theses, local, regional, national and international meetings, symposia and workshops; GIS climate, geophysical and plant maps; and an array of web pages of an array of types.

- Published 9 **refereed** journal articles and 3 **proceedings** papers.

ASSESSMENT:

All units in the Oregon Agricultural Experiment Station are required to conduct annual performance evaluation of their faculty members. These annual reviews are conducted based on goals established during previous year's reviews. Since all faculty members with OAES FTE are required to establish their station projects, annual performance evaluation serves a good vehicle to assess our progress toward the goals in our plan of work. OAES has made good progress in meeting these goals.

TOTAL EXPENDITURES:	$497,275
Hatch:	$50,457
Multistate:	$35,818
State:	$411,000

TOTAL FTE:	2.6

ACCOUNTABILITY:

Additional information regarding research programs conducted through the Oregon Agricultural Experiment Station may be found in *"Oregon Invests"*, a research accountability database accessible on the web at:

http://oregoninvests.css.orst.edu

There are currently over 346 reports contained in the database, searchable by selected criteria. Each report undergoes systematic professional review with analysis of projected economic, environmental and social effects, as appropriate.

Examples of search topics for Goal 5: rural, low-income families, community development, and employment.

KEY THEMES

Key Themes: Children, Youth, and Families at Risk

ISSUE OR PROBLEM

Poverty and unemployment rates in rural areas are typically higher, and low wages make it more difficult for families to achieve economic self-sufficiency. Provision of employment-related services such as job training, childcare, or transportation may be limited. Three years of qualitative and quantitative data collected from 475 low income rural families in 15 states allow us to examine family well-being and functioning, and community change after welfare reform.

IMPACT

The College of **Health and Human Sciences's** longitudinal research on rural poor families in 15 states is allowing us to better understand the barriers faced by such families over time. Through our analyses of the impact of health problems, food insecurity, and limited employment opportunities, we have begun to shed light on the ways in which rural poor families are coping. The importance of extended family members in contributing to economic survival is emerging, although such dependence can lead to strained family relationships.

Scope of Impact - National

Source of Funding - Hatch, State, USDA/CSREES competitive grants, National Research Initiative

Key Themes: Consumer Management

ISSUE OR PROBLEM

Marketers need to know what actions that are aimed at individuals (consumers or business customers) will trigger a desired behavior. Applied marketing research by the **Northwest Research and Extension Center** will systematically and objectively identify, collect, analyze, and disseminate information for the purpose of assisting management in decision making related to the identification and solution of problems and opportunities in agribusiness marketing.

IMPACT

The identification of motivational factors that drive a response to a product's origins allows the crafting of persuasive and tailor-made geographical umbrella brand messages. Understanding the benefits buyers associate with a given origin, their distinct lifestyle, and behavior are key prerequisites for developing a successful branding strategy for Oregon's diverse agribusiness and food industry. The research triggered development and became an integral part of the Oregon wine industry strategic plan. Other states and industries (i.e. beef, tourism, wood products, nursery stock, berries) have expressed a desire to acquire and adapt the model to meet their specific requirements.

Scope of Impact – State, regional, and national

Source of Funding - Hatch, State, commodity groups

Key Themes: Impact of Change in Rural Communities

ISSUE OR PROBLEM

Rural people want to understand how to improve labor market outcomes and to prepare for changes in demographic trends affecting rural America. They also want to understand how to revitalize economies and to decide what investments are most effective in improving rural economic well-being. The Department of **Agricultural and Resource Economics** will provide a strengthened national network of policy analysts to examine specific policies affecting rural areas and information for policy makers on strategies to improve income for low-income workers and on investments to improve community economic well-being.

IMPACT

Policymakers want to know what policies reduce poverty and whether to tailor policies to address the needs of the rural poor. As policymakers have gotten access to the department's research through publications, a national public radio interview, and presentations at government and professional conferences, the results have helped shape policy discussions of reauthorization of welfare reform and of the Workforce Investment Act. Results from the tract-level analysis of poverty rate changes suggest (1) both job

growth and increased social capital appear to have poverty-reducing effects; (2) these effects are strongest in high-poverty neighborhoods, so geographically targeted policies can enhance the efficiency of antipoverty policies and (3) there are geographic spillovers from poverty reduction neighboring tracts. During the 1990s, U.S. welfare policy was restructured, employment increased and poverty declined for single mothers in rural and urban areas. Results from a departmental study using a national sample of households suggest that, holding demographics constant, changes in welfare and social policy during the 1990s contributed to the employment increases but not to poverty reduction for both rural and urban single mothers. They also suggest that demographic differences between urban and rural single mothers in age, race, and education resulted in the policy changes having less effect on rural single mother work and poverty.

Scope of Impact – National

Source of Funding - Hatch, State, U.S. Department of Health and Human Services

B. Stakeholder Input Process

Actions Taken to Seek Stakeholder Input and Encourage Their Participation

At Oregon State University, College of Agricultural Sciences (CAS), there are several formal avenues for soliciting stakeholder contributions. These meet fairly regularly to aid in the direction and guidance of our programs. These include:

1. Dean's Advisory Council – this small advisory council is composed of industry, consumer, and environmental representatives
2. Advisory Councils of each department and branch station – these include membership drawn from the discipline or relevant region
3. Advisory Councils of each county extension office – these are more broadly based and relate to extension program areas in a county or region. Agriculture is one of the Extension program areas in Oregon.

In 2004, CAS leaders also met with a number of Oregonians who work in natural resource industries and organizations for two half days of discussions in mid June, 2004. The meeting's objectives were to:

a. conduct a forum with the College of Agricultural Sciences and its stakeholders to share and discuss the College's draft Strategic Plan, budget information, proposed Policy Option Packages, and other University issues related to the College
b. seek stakeholders' views, opinions, insights, and recommendations relating to the College's overall direction and priorities for the future

CAS administrators posed questions and listened to what attendees had to say, then compiled these stakeholders' comments, observations, and suggestions. The summary was posted on the CAS website and points were incorporated into the new CAS Strategic Plan.

OSU/CAS has and continues to solicit and receive thoughtful critiques and sometimes views that differ from its own. Responses are prepared in a timely fashion.

Research, extension and education faculty within the College of Agricultural Sciences (CAS) represent a wide array of disciplines at Oregon State University (OSU). Their scope of impact reaches stakeholders at the local, state and national levels. In an effort to solicit input from these stakeholders, there are several levels of participation which directly result in opportunities for discussion necessary for continual advancement toward recommended program goals. A sampling of actions taken are provided as follows:

1. OSU/CAS also took part in the planning processes of other units at Oregon State University, including the OSU Extension Service.
2. The College's Agricultural and Resource Economics Department is assessing the effects of university-industry relationships on the type and quantity of agricultural

biotechnology research in U.S. universities. Of particular interest is how these relationships affect the excludability of biotechnology research, that is, the degree to which the research is immediately profitable, as opposed to being useful only in the public domain.

3. The Horticulture department organized a stakeholder meeting of the nursery industry and related organizations including Oregon Department of Agriculture, USDA, Oregon Association of Nurserymen, Chemeketa, Horticultural Research Institute and the Oregon Garden.
4. Crop & Soil Science faculty annually discuss departmental priorities with commodity commissions through informal commission meetings and formal special sessions held during grower association meetings. Several faculty work with metro-based businesses (biosolids, cereal breeding, grain dealers, and milling/baking companies).
5. The Coastal Oregon Marine Experiment Station rotates their Board meetings to different locations along the coast and advertises the meetings in local newspapers. A partnership with ShoreBank Enterprise Pacific has formed the Community Seafood Initiative. The mission of this partnership is to foster entrepreneurship, and to help small and mid-size enterprises in the seafood industry to develop products and enter new markets. Engaging stakeholders of various sectors will ensure successful delivery of the program goals. A web site called "Heads-Up" disseminates information about the program as well as giving timely research information.
6. Experiment Stations throughout the state hold "Field Days" for industry and community members to observe research in progress and to discuss new issues. Grower meetings are held to seek input on research needs. Advisory board meetings are held to discuss current research programs and future research direction and needs.
7. We also have active initiatives with the Confederated Tribes of the Warm Springs and the Confederated Tribes of the Umatilla. These include a broad array of programs in education and research. These and other tribes participate in undergraduate teaching in the college particularly in developing a multicultural understanding of natural resource management. OSU degree programs in Natural Resources and General Agriculture are available at Warm Springs. The university has a long standing memorandum of understanding and cooperation with the Confederated Tribes of the War Springs that as been mutually beneficial and includes extension, academic teaching and research.
8. The college operates education programs that focus on Hispanic populations of the region. Hispanics play a major role in the agriculture of the Pacific Northwest. Areas of emphasis have been in the nursery crop and tree fruit crop growing regions of the state.

Process Used for Identifying Stakeholders and Approach Used to Collect Input from These Groups: Oregon has approximately 30 statutorily appointed commodity commissions and grower organizations. Most of these have research committees, and the

membership of these groups provide a rich source of engaged individuals from the natural resources community. Oregon has a wealth of active environmental, consumer, and community organizations including the Isaac Walton League, Oregon Environmental Council, the Nature Conservancy, Defenders of Wildlife, and Sierra Club, the Food Alliance, Oregon Tilth, and other organizations. The university has a minority Board of Visitors to advise the university and its component colleges on minority affairs. The college also has student governance through the Agricultural Executive Council. This is a very active student council with representatives from over 30 student organizations representing a broad base of students. These groups add breadth to more traditional student groups expected in a college of agriculture. These organizations provide a broad perspective for input to the management of the College.

How Input Was Considered: Pertinent feedback is received from various stakeholders on a wide range of research and program initiatives which are currently in progress. As a result of the input received, OSU administrators and faculty modify work plans to improve the design of administrative and research projects and provide specific opportunities for continued feedback. Information is disseminated to communities through newsletters, local newspaper coverage, and radio programs. Administrators and faculty use input to prioritize resource allocations, inform other researchers and policy makers of trends and concerns. Recommendations from various advisory boards represent key constituent views, and are useful in the developing extension programs which reach the agroproduction sector.

C. Program Review Process

There have been no significant changes in our program review processes since our 5-Year Plan of Work was submitted.

D. Evaluation of the Success of Multi and Joint Activities

The Oregon Agricultural Experiment Station currently has **209 scientists** who contribute to **84 multistate projects** under the five National Goals. Each multistate project submits an annual report on the group's activities, accomplishments and plans for the future. The OAES makes no attempt to evaluate any of the multistate research activities as that is accomplished through the efforts of the scientists and administrative advisors in each of those programs. The Western Research Coordination and Implementation Committee is responsible for evaluating each new or revised proposal for projects, and the AES directors approve or disapprove of them based on recommendations from the RCIC.

- National Goal #1 (W-006, W-106, W-112, W-128, W-150, W-192, W-195, W-1004, W-1133, W-1147, W-1168, W-1171, W-1177, W-1185, W-1186, WCC-093, WERA-011, WERA-027, WERA-039, WERA-043, WERA-055, WERA-058, WERA-060, WERA-067, WERA-069, WERA-072, WERA-077, WERA-081, WERA-089, WERA-097, WERA-099, WERA-101, WERA-110, WERA-204, NC-131, NC-1142, NCR-131, NCR-173, NCR-180, NCERA-190, NE-124, NE-132, NE-183, NE-1011, NE-1012, NE-1018, S-290, S-1004, S-1007, NRSP-3, NRSP-6),
- National Goal #2 (W-150, W-1122, NE-1018),
- National Goal #3 (W-1002, W-1003, W-1122, WERA-027, WERA-103, NC-136),
- National Goal #4 (W-045, W-128, W-150, W-170, W-1133, W-1147, W-1185, W-1186, W-1190, WCC-1003, WERA-040, WERA-043, WERA-058, WERA-060, WERA-077, WERA-081, WERA-089, WERA-097, WERA-099, WERA-102, WERA-103, NC-140, NCERA-059, NCR-173, NCR-193, NE-103, NE-132, S-1020, NRSP-3),
- National Goal #5 (W-128, W-167, W-192, W-1177, WERA-055, WERA-058, WERA-207, WERA-208, WERA-1001, NC-1011, NE-1012).

The OAES actively encourages our scientists to participate in multistate activities. We continue to monitor our progress.

Oregon State University has a unique organizational approach that integrates research, extension and credit education programs. All of the faculty in the statewide branch stations have an academic home in a campus department. They are full members of the department faculty and are fully enfranchised in the departments, colleges and university. For example, extension faculty stationed in a county hold an academic appointment in a department and fully participate in promotion and tenure activities of the department. They hold tenure track and professorial positions. They are fully represented in the Faculty Senate of the university. They plan and implement education (both academic and extension) and research programs in a fully integrated fashion.

E. Integrated Research and Extension Activities

Oregon State University has a unique organizational approach that integrates research, extension and credit education programs. All faculty in the statewide branch stations have an academic home in a campus department. They are full members of the department faculty and are fully enfranchised in the departments, colleges and university. For example, extension faculty who are stationed in a county hold an academic appointment in a department and fully participate in promotion and tenure activities of the department. They hold tenure track and professorial positions. They are fully represented in the Faculty Senate of the university. They plan and implement education (both academic and extension) and research programs in a fully integrated fashion. The following eight (8) projects are good examples of our efforts in the integrated research and extension activities.

Title: Sustainable Soil, Water And Crop Management Strategies For Semiarid Oregon

Issue: Soil and water conservation are very important in sustaining dryland farming in semiarid Oregon. Adopting direct seed farming and producing high end use quality wheats are important aspects that will keep farms in Oregon profitable. This project examines direct seed farming practices and nutrient management strategies. The purpose of this project is to test and develop conservation farming practices that protect soil health and water quality and improve wheat end use quality and maintain or enhance current wheat markets.

What has been done: Tillage, residue management, and soil and water conservation practices will be evaluated at OSU research facilities and in on-farm tests in grower fields in semiarid Oregon. Direct seed experiments will be conducted at locations in grower's fields. Research will focus on direct seeding practices and reduced tillage plantings of cereals, Canola and yellow mustard. Plots are harvested using grower combines and a weigh wagon or a plot combine. As experiments are completed, new studies of various management practices will be undertaken. When historical data and information from long term plots exists, it will be used to identify data gaps and the need for new research. Possible candidates for future projects include the role of incorporated residue in controlling erosion, planting options using chem-fallow, use of fire as a management tool, and direct drilling of canola and mustards. These projects will be jointly undertaken with cooperation of USDA-ARS scientists and local or campus based OSU faculty, or WSU and U of I scientists.

Impact: Cropping systems research was conducted on nitrogen fertility management of hard white winter wheat, hard red spring wheat, hard white spring wheat and soft white spring wheat. Trials were direct seeded in the fall or spring at two locations in eastern Oregon resulting in 265 experimental units. Results of these trials collectively show that among fertilizer treatments and varieties optimum nitrogen fertilizer varied significantly with landscape position, soil depth and available water. The optimum rate varied between 0 and 100 lb/acre. Cultivar trials of 24 lines of winter canola produced up to 4000 lb/seed per acre

at Hermiston, Oregon. Spring yellow and brown mustard and canola grown under various residue management treatments yielded 1800 lb/acre. Residue was left standing, burned, harrowed, or flail mowed. Canola was more sensitive to residue than either brown or yellow mustard. Direct seeding of winter and spring cereals varies between 10 and 80 percent of cropland acres in counties in eastern Oregon and Washington. Information from direct seeded wheat and nitrogen management is helping growers refine fertility rates and apply the appropriate amount of nitrogen, phosphorus and sulfur. Canola research has enable growers to direct seed into chemical fallow and produce acceptable stands and consistent yields. Growers have pooled funds and sought grant money to form an LLC to market value added products from canola. A business plan is being prepared for the LLC.

Title: Genetic Resistance To Cereal Root Diseases: Fusarium, Pratylenchus And Heterodera

Issue: Fungi and nematodes that invade root systems reduce production efficiency for wheat and barley. Chemicals, genetic resistance and economical crop management practices are not available for reducing economic damage. This project will examine a broad range of wheat and barley germplasm to identify sources for genetic resistance to *Fusarium* crown rot, root-lesion nematode and cereal cyst nematode.

What has been done: Diverse wheat and barley germplasm were acquired from plant breeders, and screened under controlled-environment and/or field conditions. An associated study identifies information required for selecting plants with appropriate resistance genes identified overseas during the past decade. The project team applies PCR, RFLP and/or other molecular diagnostic technologies to improve clarity for identifying fungal and nematode species that are not easily separated by morphological parameters. Promising wheat and barley lines with genetic resistance to one or more of the soilborne pathogens or parasites will be identified for potential use as parental lines in crossing programs directed by wheat and barley breeders particularly in Pacific Northwest states but also in other states and the international centers. Lastly, the project will identify crop management systems that minimize economic damage from root-infecting soilborne pathogens and parasitic nematodes, and will provide diagnostic support and/or disease identification and quantification services for research and extension programs directed by other scientists in eastern Oregon and Washington.

Impact: Wheat producers in the Pacific Northwest have a strong interest in converting winter wheat/summer fallow rotations into cropping systems that are more environmentally acceptable, and sustainable. Many growers are making the conversion from wheat/fallow rotation to annual cropping systems, without tillage. Opportunities to rotate crops are limited by marketing and production constraints, leading many growers to plant wheat or barley annually. This research demonstrated that populations of root-lesion nematodes became greater as cropping frequency increased, and that these nematodes reduced yields of intolerant wheat varieties as much as 60 percent. All wheat varieties adapted to the Pacific

Northwest are thought to be intolerant of lesion nematodes. Following this demonstration of economic damage, imported wheat genotypes thought to have higher levels of tolerance or resistance to this pest were screened to determine which should be transferred to wheat breeding programs, to be used as parental lines in crosses designed to improve yield stability for wheat planted annually in the Pacific Northwest. Similar lines of research were performed to document economic damage by cereal cyst nematode and *Fusarium* crown rot. Sources of genetic resistance to the cereal cyst nematode and fungal pathogens that cause crown rot were also imported and are being screened to determine which may be of value in wheat breeding programs in the Pacific Northwest. There does not appear to be comparable research elsewhere in North America. A web site was published to improve access to this research; http://cbarc.aes.oregonstate.edu/cbarc/plantpathologyhome.php.

Title: Integrated Pest Management (IPM) Of Arthropods Of Pear In Southern Oregon

Issue: Managing pests in a cost-effective and environmentally friendly manner is an important component of a profitable and sustainable tree fruit industry in Oregon. The goal of this research is to develop and implement an integrated pest management program in tree fruit, which minimizes the use of disruptive, broad-spectrum pesticides and maximizes the benefits of naturally occurring biological control agents through the use of selective pest management techniques. The project will also look at the impact that ground covers may have on pests and beneficial species. In chemically constrained systems, emphasis will be given to pesticide resistance management, and evaluation of new pesticides for efficacy and impacts on beneficials.

What has been done: The integrated pest management program conducted cooperative research as part of IFAFS and RAMP grants led by Washington State University and the University of California, respectively. Three on-farm demonstration blocks were followed throughout the 2004. In all three blocks, mating disruption was used as the primary control for codling moth and no applications of organophosphate or carbamate insecticides were required. Codling moth granulosis virus, another highly specific and relatively non-toxic control for codling moth, was tested both at the Research Center orchard and in a grower orchard. The results with this biological control method continue to look very promising. A study funded jointly by the Oregon Bartlett Pear Commission and the Washington Tree Fruit Research Commission examined the use of the granulosis virus in conjunction with mating disruption for control of codling moth, results indicate that in areas of high codling moth pressure the addition of mating disruption may not be cost effective versus a program featuring more intensive use of the granulosis virus. Studies on trapping codling moth using a kairomone (pear ester) which attracts both male and female moths demonstrated that this new technology can be used effectively in pears, and may be used to time sprays with greater precision so that materials such as the granulosis virus, which are limited by their lack of residual activity, can be applied when egg-laying by females is at peak levels. Numerous trials were conducted at the Research Center orchard in conjunction with agricultural chemical companies to evaluate new materials. One on-going research project,

which was partially funded by the Winter Pear Research Committee, assessed the effect of a number of novel chemical controls on the European earwig, which can act as a beneficial insect in pome fruit. Information from this research on the sublethal effects of spinosad on earwigs was utilized by orchardists during the 2004 season. Meetings with local growers were conducted on a biweekly basis throughout the growing season to discuss pest management options. The Pest Alert web page developed in 2002 continues to be updated and improved.

Impact: Adoption of IPM technologies in southern Oregon orchards, when done correctly, has been shown to result in reduced pesticide use while maintaining high standards of fruit quality. Approximately 40% of the local tree fruit acreage (3,000 acres) is currently utilizing mating disruption based IPM programs with minimal use of problem insecticides (e.g. organophosphates, carbamates, pyrethroids), with at least one-third of the acreage using no organophosphates or carbamates in 2004. An additional 50% of the tree fruit acreage (3,600 acres) employs monitoring of pest populations and use of weather data and phenology models to predict pest development, together these data are used to reduce the number of unnecessary pesticide applications. Access to these weather data and phenology models has been facilitated by the Pest Alert web page, which has had over 20,000 hits. During 2004, over 50 acres of orchards are in the process of transitioning to organic fruit production, utilizing organically approved pest management tactics such as mating disruption, codling moth granulosis virus and kaolin particle films, which were first tested locally at the Research Center. Growers representing two-thirds of the tree fruit acreage attended the biweekly pest management forums and discussed monitoring methods and results, and used this information to modify and improve their pest management programs.

Title: The Molluscan Broodstock Program

Issue: The West Coast oyster industry is dependent on hatcheries for production of seed for grow-out to market size. The Molluscan Broodstock Program was established in 1995 to improve meat yields of commercially farmed Pacific oysters through genetic selection and to provide industry with genetically superior broodstock for commercial production. The Broodstock Program will improve meat yields through the application of modern molecular genetics, classical selective breeding, and effective outreach to industry.

What has been done: The Molluscan Broodstock Program (MBP) will genetically select broodstock from cohort of 50 full-sib families planted at commercial grow-out sites in Alaska, Washington, Oregon, and California. The primary selected trait is meat yield that is dependent on both oyster growth and survival. Microsatellite and allozyme markers will be used to determine genetic composition and pedigree of MBP families. Selected pedigreed families will be provided to the West Coast oyster industry for use as broodstock in commercial hatcheries. A repository at the Hatfield Marine Science Center, Oregon State University, ensures long-term availability of selected Pacific oyster broodstock.

An overall 9.5% improvement in yield of MBP oyster families was observed after one generation of selection. In 2004, results of harvested cohorts from the third generation indicate substantial improvements in yields of progeny from selected broodstock. These broodstock will be available to commercial hatcheries in 2005. Demand for MBP broodstock by commercial hatcheries has been so great that supplies were exhausted in 2003 and 2004. In response to this, the program is seeking a permit to establish a commercial oyster repository in Netarts Bay, Oregon, that will be able to supply industry with substantially larger numbers of broodstock. In addition, in 2004 results of a large-scale experiment to determine the effects of nursery and grow-out environments on relative family performance found that there was little environment x genotype interaction effect of either nursery or grow-out environment on yields, confirming previous results that showed that it was possible to identify "generalist" families that performed well across a range of different environments. Studies to determine heritability for high growth rate found a heritability value of 0.33 for growth of offspring that were cultured in the same environment as their parents, but heritability was 0 when parents and offspring were reared in different environments.

Impact: The West coast hatchery is benefiting from the use of MBP broodstock for commercial seed production and advice in broodstock management. Commercial hatcheries using MBP broodstock have produced large numbers (billions) of seed for the West Coast industry and foreign markets. Increased production through the use of MBP broodstock could be valued as high as $6.5 million, given that the West coast annual oyster harvest is valued at $68 million and we expect a 9.5% improvement in yields of offspring from MBP selected broodstock.

Title: Improving Microbial Safety Of Northwest Fresh And Processed Berries

Issue: Fresh Northwest berries and their juices and purees have challenged the belief that high acid foods cannot harbor viable pathogenic bacteria. They could also act as a vector for foodborne illness. This project is to enhance and ensure the safety of Northwest fresh and processed berries through integrated research, education and Extension efforts.

What has been done: Research efforts focused on identifying the modes of contamination in animal manures from various resources and developing strategies to control microbial growth on the surface of fresh berries. Results indicated that chitosan coating of fresh berries has strong antifungal function against Cladosporium sp. or Rhizopus sp. during storage; the coating treatment also reduced total aerobe count, coliforms, and weight loss of strawberries during storage. A 3-credit undergraduate course in Food Safety and Sanitation covered broad topics from basic food microbiology, important foodborne pathogens, sanitation principles, to developing a HACCP program. Of the 42 students in 2004, 27 of them took the national exam of Food Safety Manager Certification, and all of them received the certificate. Extension efforts informed Northwest berry growers and processors of the importance of microbial safety in berry production and processors and implementing GAPs,

GMPs, SSOPs, and HACCP in their operations. A 36-page document, "Enhancing Microbial Safety of Northwest Fresh and Processed Berries," was used as a guideline and distributed to the growers and processors. This project was presented in various regional berry meetings, including the Northwest Center for Small Fruit Research Annual Conference. In December 6, 2004, a one-day workshop on Good Agricultural Practices (GAPs) for Fresh Fruit and Vegetables was offered in Corvallis, OR. Twenty six Oregon and Washington fruit and vegetable processors, growers, and state legislators participated, ranking this workshop Very Good to Excellent. A poster presentation of this project was also given at the Oregon State University Extension Conference in September 21-22, 2004.

Impact: Increasing the understanding of the microbial safety of Northwest berry fruits, assisting the berry growers and processors develop high quality and safe products, and educating college students in food safety and sanitation are critical to public health and regional agriculture and industry. Workshop participants reported that the training enhanced their understanding on the importance of SSOPs and HACCPs, and improved their knowledge in developing HACCP plans.

Title: Value-Added Processing For Fish And Fishery By-Products

Issue: Conventional protein recovery system yields 20-25%, resulting in a significant amount of proteinous materials unused. Surimi processing also leaves 33,000 mt of refiner discharge in the U.S. each year. Dark muscle fish such as sardine has not been utilized as human food yet. This project will investigate a new protein recovery system, using pH shift, for the recovery of functional proteins from Pacific whiting and sardine. In addition, consumer-friendly gelatin from surimi by-products will be developed. The overall objective is to investigate various ways for maximum utilization of fish and fishery by-products through protein recovery using pH shift and upgrading feed/waste to food.

What has been done: Three different solid by-products (skin, frame, and refiner discharge) from Pacific whiting surimi manufacturing were a good resource for collagen extraction according to their total protein concentrations and other biochemical properties. Denaturation temperature of acid-soluble collagens was 23.3C for refiner discharge, 21.7C for skin, and 20.6C for frame. Based on the functional properties, acid-soluble collagen from refiner discharge was the best and showed a potential as an ingredient in processed food manufacturing.

Impact: Valued-added products like fish sauce developed using surimi by-products would give manufacturers a chance to upgrade feed to food. Our research indicated that Pacific whiting fish sauce can replace imported anchovy fish sauce that contains histamine. Pasteurization models developed in this project would allow manufacturers to predict pasteurization temperature with different package dimensions. Partially purified collagen from refiner discharge could be used as an effective emulsifier in the meat, confectionary,

and mayonnaise industries. Gelatin could be further hydrolyze to be antioxidative peptides. Fish gelatin could be used as a raw material for medicine capsules.

Title: Bridging The Divide - Collaborative Integration Of Research And Community Development

Issue: There is a need to maximize the economic impact of existing and future research on rural and distressed coastal communities in Oregon and Washington and elsewhere. It is important as well to involve communities in rebuilding their economy and protecting their natural. This project will use a coordinated network of institutions and industry groups that combines research, education, and community and economic development in a community-based delivery model to support rural communities. The collaborators include the OSU Seafood Laboratory and Coastal Oregon Marine Experiment Station, the Duncan Law Seafood Consumer Center (a non-profit regional facility providing links between the seafood industry and the consumer, and promoting the consumption of seafood through education, training, research and dissemination of information) and Shorebank Enterprise Pacific (a non-profit conservation-based loan fund that services the Oregon and Washington coast, specializing in providing capital and business services to promising ventures which add value, provide quality employment opportunities, and offering long term economic and environmental integrity to rural coastal communities).

What has been done: Building off of three years of successful collaboration on specific initiatives, the project is organized under three functional areas: research and technology, education, and extension and implementation. This approach will be applied to four current research efforts - two focused on new technology and two focused on product development and diversification: 1) High Hydrostatic Pressure (HHP) Oyster Processing Technology 2) Fisheries Based Electronic Information System Technology (Log Book) 3) Albacore Tuna Product Diversification 4) Oyster/Shellfish Product Diversification.

The 2004 calendar year work focused on albacore tuna which is primarily sold whole, frozen and used as raw material for canned products in foreign and domestic markets. However, efforts are currently underway to introduce West Coast albacore into alternative markets as high quality loins and steaks. Collaborators tested computerized units onboard fishing vessels that rapidly recorded traceability information under actual working conditions. Further, more than 80 albacore tuna captured off the Oregon coast were tagged and marked for traceability with bar codes. These fish were then canned at a local custom canner and marked with a specific code that can be traced back through a web-site by the consumer. A survey of consumer acceptance for this system will be undertaken in the following years. Project results also indicate that West Coast troll-caught albacore have low levels of mercury in the edible flesh and are well within international safety standards for mercury levels in fish.

Impact: The effort by the albacore industry to improve the onboard handling methods for their fisheries has led to increased ex-vessel price for fishermen that land high quality fish.

Several local producers have also begun marking their products with traceability information to better inform their customers about the fisheries and their product. The results from the mercury study have greatly improved the marketability of troll-caught tuna from the West Coast of the U.S. Several fishermen and processors (mainly canners) have used the information from this research to market their product and differentiate their tuna from national brands. This has created a significant demand for local caught albacore in both the frozen state and canned product and has resulted in a significant increase in the ex-vessel price to the fishermen as well as an increased demand for troll-caught canned albacore tuna. This information was presented to fishermen at the Western Fish Boat Owners Association annual meeting in Las Vegas, March 24-25, 2004 and the Fishermen-Chef Market Connection workshop for regional fishermen and fish buyers in Portland, OR April 5, 2004.

A major effort for this project is the development of new value-added products from albacore tuna and shellfish, such as oysters. This project demonstrated the feasibility of using new product development techniques such as Culinology in developing new products. Two new products are being introduced into the marketplace. We expect that these products will be successful over the next few years. An additional expected outcome will be a wider recognition of the project and the value-added process by small and mid-size businesses. We expect that there will be increased opportunities and interaction amount the project partners and businesses for future product development activities.

Title: Ecological Analysis Of Rural Land Use Practices

Issue: There is data to suggest the decline in agroecosystem biodiversity is related to changing agricultural practices, and these changes have caused declines in a wide variety of plants and animals. For example, there is evidence that nesting populations of ferruginous hawks and Swainson's hawks are declining nationally and being replaced by red-tailed hawks (the white-tailed deer of the raptor world) as human disturbance increases in native rangelands. It is important to determine the landscape and land use factors that contributed to supporting earlier abundant raptor populations as well as to evaluate past and present trends in landscape change. Such information will allow the development of sustainable rural land use practices that include mitigation of direct lethal effects, e.g., reducing electrocution of raptors by rural powerlines, and enhanced habitat management, e.g., development of ecologically sustainable grazing practices. .

What has been done: The project team from the Departments of Rangeland and Fisheries & Wildlife and from the Eastern Oregon Agricultural Research Center and the Hermiston Agricultural Research and Extension Center developed an integrative, collaborative program that combines correlative studies to identify patterns of response to land use practices and experiments to identify processes influencing these patterns. The studies incorporate a variety of temporal and spatial scales with an emphasis on functional scales appropriate to the study organism(s) and the management alternative(s), as well as a wide range of taxonomic responses to land management practices in western rangelands. The most recent

external grant received will support a landscape analysis of the Zumwalt Prairie Raptor Habitat in Northeastern Oregon, including an evaluation of the historic aerial photo data available for the study area to determine how the landscape has changed over the past 70 yr from the ecological viewpoint of a nesting prairie raptor. This area is very unique and of high conservation value because it is the last large (160,000 acres) area of native northwest bunchgrass prairie. It is 100% in private ownership (currently 35 landowners) and the dominant land use is cattle grazing.

Impact: The collaborators will produce ecological information that can be used by scientists, managers, policy makers and local landowners to identify and develop natural resource management practices that both maintain biodiversity and are economically viable. Community involvement in the projects on the Zumwalt Prairie project is high; 24 landowners are participating in the project by allowing access to their land.

The results of this program will be used to develop sustainable rural land use practices that include mitigation of direct lethal effects, e.g., reducing electrocution of raptors by rural powerlines, and enhanced habitat management, e.g., development of ecologically sustainable grazing practices. This integrated program will increase our understanding of the effects of rural land use practices on biodiversity in western rangelands.

Title: Utilization Of Municipal And Industrial Byproducts In Agriculture

Issue: Byproducts from farms, industry, and cities have nutrient value for crop production, but careful management practices are needed to protect environmental quality. Projects with municipal biosolids, wood ash, paper processing sludge, food processing residuals, and composts are underway or anticipated. Understanding and managing nitrogen and phosphorus in byproduct-amended soils is identified as a key area of project focus across a variety of industrial and municipal byproducts. This project develops guidelines for appropriate utilization of byproducts to protect environmental quality and to provide economical alternatives to landfill disposal or incineration.

What has been done: The team from Crops and Soil Science has used laboratory incubations, field experiments, and computer simulation models to quantify nutrient dynamics and to develop appropriate guidance for farmers, regulatory agencies, and byproduct generators. They have made estimates of the plant-available nitrogen provided by yard trimmings needed to meet grower demands and environmental regulations. They: (i) estimated available N provided by yard trimmings containing grass clippings and woody plant materials (ii) evaluated the impact of aging on available N supplied by grass clippings, and (iii) identified laboratory analyses that are correlated with N mineralized from yard trimmings in soil. Based on the present study, it appears unlikely that excess N will be provided by typical application rates of mixed yard trimmings. Mixed yard trimmings with typical moisture of 600 g kg-1, total N of 17 g kg-1 (dry matter basis), and N availability equal to 15% of total N, supplied approximately 1 kg available N per metric ton.

Impact: Land application of yard trimmings from urban landscapes on farmland is an emerging recycling alternative in the Pacific Northwest. This research, which determined typical amounts of plant-available nitrogen provided by yard trimmings, has been incorporated into Extension guidance for Oregon and Washington State. The use of yard trimmings as a soil amendment and nitrogen source is of particular interest to farmers interested in non-chemical sources of nitrogen for crop production.

U.S. Department of Agriculture
Cooperative State Research, Education, and Extension Service

Supplement to the Annual Report of Accomplishments and Results
Multistate Extension Activities and Integrated Activities

Institution: Oregon Agricultural Experiment Station
State: Oregon

Check one: ____ Multistate Extension Activities
__X__ Integrated Activities (Hatch Act Funds)
____ Integrated Activities (Smith-Lever Act Funds)

Actual Expenditures

Title of Planned Program/Activity	USDA Goal	Hatch
An agricultural system that is highly competitive in the global economy	1	$ 1,733,262
A safe and secure food and fiber system	2	$ 251,217
A healthy, well-nourished population	3	$ 115,278
Greater harmony between agriculture and the environment	4	$ 520,515
Enhanced economic opportunity and quality of life for Americans	5	$ 86,275
Total		**$ 2,706,547**