Plan of Work Report

(7/3103 revision of the final draft)

University of Idaho

College of Agricultural and Life Sciences

Idaho Agricultural Experiment Station

Federal Fiscal Year
2002

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Plan of Work for the College of Agriculture and Life Sciences, Idaho Agricultural Experiment Station (IAES), University of Idaho

Introduction

This Plan of Work report describes the research programs and impacts of the College of Agricultural and Life Sciences and the Idaho Agricultural Experiment Station (IAES) for fiscal year 2002, as required by the Agricultural Research, Extension, and Education Reform Act of 1998 (AREERA).

Contact Person

Dr. Richard C. Heimsch, Director
Idaho Agricultural Experiment Station (IAES)
College of Agriculture
University of Idaho
Moscow, Idaho 83844-2337
Voice: 208-885-7173
FAX: 208-885-6654
Email: agres@uidaho.edu

Background Information

University of Idaho

The University of Idaho was created in 1889 by the territorial legislature with a major objective to offer all people higher education in the arts, letters and sciences. Total enrollment during the 01-02 academic year was 12,067 including 2,986 graduate students, and 303 law students. The University serves as the main center for research, professional education and research-based graduate programs and has the primary responsibility for granting the Doctor of Philosophy degree in the state of Idaho. In order to carry out its statewide mission, the University maintains instructional centers in Coeur d'Alene, Boise and Idaho Falls. Off-campus instruction is also presented at extension offices in 42 of 44 counties, 8 research and extension centers and 4 field stations.

The University of Idaho is a Doctoral/Research University-Extensive, the most comprehensive Carnegie Foundation rankings among Ph.D. granting research universities. The National Science Foundation (NSF) reports that UI historically receives 80-85% of all federal agency science and engineering research funds awarded to Idaho universities and colleges. In its latest available ranking, NSF reports UI ion the top 25% (119 of 547) of U.S. universities and colleges in total research and development expenditures from all sources. There has been a 68% increase in total research funding from all sources since 1991.

College of Agricultural and Life Sciences

In addition to traditional campus instruction, the College of Agricultural and Life Sciences at the University of Idaho serves communities across the state with agricultural and family and consumer science research, and extension or "outreach." The fall 2002 enrollment totaled 1,054, which is an all-time high for the College. The FY02 budget, including all revenue sources, was $60.3 million. The college maintains ten agriculture research centers across the

state to meet unique regional research needs. Almost half of the 214 college faculty members and 300 staff (210 permanent staff positions) are located off of the Moscow campus at research centers and extension offices. Since the last reporting period, the College of Agricultural and Life Sciences has experienced severe budget reductions that have resulted in an approximate 15% reduction in both faculty and support staff positions

Idaho Agricultural Experiment Station (IAES)

The Idaho Agricultural Experiment Station (IAES) was created in 1892 with a federal allocation due to the Morrill Act (1862), which established the U.S. land-grant educational system and the Hatch Act (1897). The College of Agricultural and Life Sciences has always been a major contributor to research efforts at the University of Idaho due the basic philosophy that founded the land-grant educational system and the fact that agriculture has always been a major segment of the Idaho economy. The IAES and College of Agricultural and Life Sciences have a long tradition of supporting Idaho and Pacific Northwest agriculture, rural communities and families, and food processing industries with information derived from its agricultural research programs

IAES Program Impacts FY02

Goal 1: An Agricultural Production System that is Highly Competitive in the Global Economy

IAES Program 1: Plant Germplasm, Genetic Resources and Conservation, Plant Health and Well being (RPAs 102, 123, 201, 202, 203, 204, 205, 206, 211, 212, 213, 214, 501, 502). This program area constitutes the largest program of the IAES and includes 40 research projects enrolled in CRIS and about 25.8 Scientist Years (SY) of research effort.

Performance Goals:

Identify and manipulate plant germplasm to improve crop plant performance and the production of seed and other plant products. Develop economical, biological and socially compatible crop management strategies that increase production efficiency.

Progress/Impacts:

1. PLANT GENETIC RESOURCE CONSERVATION AND UTILIZATION

Investigators: Zemetra, R. S.
Termination Date: 09/30/2003
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:

Utilzation of germplasm in Idaho in 2002 increased in number of species (201)and total number of accessions (1,073) requested compared to 2001. The number of individuals requesting germplasm was 38, which was also an increase compared to 2001. Of the 38, 17 were from public research programs and 21 were from private individuals or companies. At the University

of Idaho, utilization of germplasm occurred in the bean and wheat breeding programs. Wheat and jointed goatgrass accessions continue to be used to study the potential for gene migration between wheat and jointed goatgrass. A Recombinant Inbred Line (RIL) population is being produced using two soft white winter wheat cultivars to provide a research population to develop molecular markers for traits of interest in the Pacific Northwest.

Impact:
Utilization of germplasm by public and private programs/individuals should result in improvement of crops for producers in the Pacific Northwest and the nation. Consumers should benefit from improvements in crops with improved disease resistance,insect resistance and end-use quality. Research on gene flow between wheat and jointed goatgrass should result in the development of a management strategy to minimize the potential for migration of transgenes from wheat into jointed goatgrass. Development and utilization of a soft white winter wheat RIL population should result in the development of molecular markers that could improve the efficiency of developing improved cultivars for the Pacific Northwest.

2. BIOLOGICAL CONTROL IN PEST MANAGEMENT SYSTEMS OF PLANTS

Investigators: Johnson, J. B.
Termination Date: 09/30/2002
Reporting period: 10/01/1997 to 09/30/2002

Termination Report:
This project followed a preceding project that focused on releasing and establishing natural enemies of the Russian wheat aphid, Diuraphis noxia. It primarily examined native and introduced aphidophages in wheat in Idaho. The dominant Coccinellidae occurring in northern Idaho wheat are Hippodamia convergens and Coccinella septempunctata. Coccinella transversoguttata and C. trifasciata also occur. We examined early spring plant preferences among these species. If one crop (wheat, canola or lentils) had far more aphids than the other crops, all species of ladybugs tended to be most abundant in that crop. When aphid abundances were more uniform among the crops H. convergens tended to be more abundant in wheat fields while C. septempunctata and C. transversoguttata tended to be more abundant in lentil fields. However, when aphids were scarce in all three crops, coccinellids were most abundant in canola, where they fed on pollen. This indicates that having all three crops within an area has the potential to be beneficial to the resident coccinellid community. However, depending on the pattern of aphid abundance in a given year, the crops may sequentially share or compete for the predators. We attempted to determine a basis for this preference with a small cage laboratory study. Hippodamia convergens preferred wheat. Coccinella transversoguttata did not show a preference. The C. septempunctata colony failed, so it could not be tested. A second component of the project examined the interaction of aphidophages and susceptible (Stephens) and Russian wheat aphid resistant (#10085, with genes for resistance from PI294994) wheats. The Russian wheat aphid resistant wheat supported normal populations of other cereal aphids. The Coccinellidae showed no preference for either wheat. Small plot trials showed that seven species parasitoid Hymenoptera (Braconidae: Aphidiinae and Aphelinidae)were attacking cereal aphids near Moscow, ID. Among these species, only Diaeretiella rapae, which prefers the Russian wheat aphid as a host, was less abundant on the Russian wheat aphid resistant wheat. Overall parasitism rates of the entire aphid community did not differ significantly. Two of the parasitoid

species yielded confirmations of establishment of introduced biological control agents in Idaho. Scymnus frontalis was released in Idaho for control of the Russian wheat aphid. We examined the influence of susceptible and resistant wheat (same genotypes as above) and nitrogen fertilization rates (1%, 10% and 100% of normal) on this predator in the laboratory. The resistant wheat supported fewer Russian wheat aphids at all levels of nitrogen fertilization. The lowest level of N reduced tolerance wheat for Russian wheat aphid, but did not inhibit antibiosis. Scymnus frontalis developed more quickly and grew larger on both wheats at 10% of the normal N fertilization. The resistant wheat had a slight detrimental effect on S. frontalis. Adult beetle eclosion weight was reduced 0.02-0.09 mg and developmental time was 0.4-2.0 days longer from hatching to adult eclosion when S. frontalis larvae were fed Russian wheat aphids reared on the resistant wheat.

Impact:
Understanding the interactions between pest resistant crop varieties, biological control agents and production practices is necessary if we are to optimize biologically-based pest management. Growers will be able to ensure that they derive the greatest possible benefits from the purchase of pest resistant crop varieties, e.g. the additional benefit of maintaining optimal tolerance to the Russian wheat aphid by ensuring adequate nitrogen fertilization. Knowledge that the resistant varieties derived from PI294994 do not interfere with aphidophage activity can further reduce pest management costs by reducing insecticide use and thus reduce the risk of environmental damage and the development of insecticide resistance. The possibility of crops sharing polyphagous aphidophafes lends further support for the economically sound practice of growing an array of crops.

3. ROOTSTOCK, INTERSTEM, FERTIGATION, & STRAIN EFFECTS ON TREE GROWTH & DEVELOPMENT, NUTRITION

Investigators: Fallahi, E.
Termination Date: 06/30/2002
Reporting period: 12/01/1997 to 06/30/2002

Termination Report:
This project had three main objectives: Studying tree growth, nutrient partitioning, and postharvest physiology of `Fuji' apple as influenced by: 1) various rootstocks and five fertigation regimes; 2) inter-stem of 'Fuji' onto `Rome' inter-stems; 3) root competition with various rootstocks and tree densities. The five-fertigation treatments are as follows: 1) 22.4 kg N/ha/year; 2) 89.7 kg N/ha/year; 3) 89.7 kg N/ha/year plus 78.5 kg K/ha/year; 4) 156.9 kg N/ha/year; 5) 156.9 kg N/ha/year plus 78.5 kg K/ha/year. Preliminary data also showed that mineral concentrations of leaves from various strains of 'Fuji' do not significantly vary. Trees from 22.4 kg N/ha zone had lower leaf N, leaf area, photosynthesis, and lower yield but better fruit color than those with higher N rates. Fruit from the high N treatment had higher evolved ethylene and respiration after storage. Four years after planting, trees on M.7 EMLA had higher yield than those on other rootstocks. Ottawa-3 had higher photosynthesis and better overall fruit quality than those on other rootstocks. Trees on B9 had lower leaf N, smaller fruit, and higher fruit Ca and higher evolved ethylene than those on other rootstocks. Trees on B.9 had the smallest Trunk Cross-Sectional Area (TCA) and the shortest limbs and terminal shoot. The density of non-flowering spurs in the scion trees increased with the vigor of rootstocks. Bud break in the mixed-

buds of trees on of M.7 EMLA was slower than those on B.9 and O.3. Shoot and spur leaves, and fruit tissues of trees on M.7 EMLA had significantly higher K concentrations than those on other rootstocks. Shoot leaves and mixed-buds of trees on M.26 EMLA had higher Mg concentrations than trees on most other rootstocks. Trees of 2.43 m spacing had significantly higher photosynthesis than those of 1.22 m spacing. 'Fuji' fruit quality and mineral elements of trees were not affected by tree spacing.

Impact:
This project has been extremely useful for the fruit growers of PNW and other similar areas. Growers have a better idea on the range of nitrogen fertilizer required for optimum quality when a micro-jet sprinkler is used. They also have a much better knowledge of rootstock effects on yield, growth and fruit quality in 'Fuji' apple.

4. VARIATION IN SURFACE WAXES AND PREDATION IN PEAS AND OILSEED BRASSICA

Investigators: Eigenbrode, S. D.
Termination Date: 06/30/2002
Reporting period: 01/01/1998 to 06/30/2002

Termination Report**:**
The objectives of this project were to quantify the effects of surface wax mutations in Brassica crops and peas, Pisum sativum, on natural enemies of insect pests, to understand the mechanisms governing these effects, and to work towards development of crop varieties with surface waxes altered in order to improve biological control in these crops. Altogether, the effects of 3 mutations in P. sativum, 5 mutations in B. oleracea, and 3 mutations in B. napus were examined for their effects on pest densities, predators or both. Field and laboratory tests were employed. In peas, we have shown that 1) pea aphid populations are reduced on pea plants with reduced surface waxes, 2) two important predators and the most important parasitoid in local system perform better at attacking pea aphids on reduced wax peas, 3) in the field, excluding predators largely eliminates differences in pea aphid populations associated with differences in surface waxes, thus implicating predators in the apparent resistance of reduced wax peas to this pest, 4) interactions among certain foliar foraging predators are affected by waxy bloom on peas, but interactions involving ground-dwelling predators are not, 5) responses to surface waxes differ within the entire insect community associated with peas, 6) a fungal pathogen of the pea aphid, Pandora neoaphidis, causes more mortality on reduced wax peas in the field and laboratory, apparently due to greater attachment by the fungal spores to leaves of reduced-wax peas, 7) several mutations affecting surface waxes of peas are beneficial to predators and one of these mutations may be suitable for cultivar development. In Brassica, we have shown that 1) effectiveness of predators is enhanced in proportion to wax crystal reduction across a range of mutations, 2) in the field, cabbage aphid populations are lower while predator populations are higher on a reduced wax oilseed variety, 3) yield of this variety is apparently not too strongly reduced by the wax reduction, 4) applications of thiocarbamates are capable of reducing surface waxes on oilseed Brassica, but the effects are not sufficiently strong to provide protection against insect pests, 6) the effect of waxy bloom on attachment by a predator to the plant surfaces is influenced by crystal density but is also affected by the chemical composition of the waxes, 7) all but one predator species examined has shown improved efficacy on reduced wax plants.

Impact:
The general principal that reduced surface waxes can enhance the effectiveness of natural enemies of pests has been thoroughly demonstrated by this project. As a result, it is an accepted phenomenon among biological control specialists, likely to influence efforts to improve biological control. Eventual development of cultivars with reduced waxy blooms is feasible, based on the results of this project.

5. DOMESTICATION OF WESTERN HUCKLEBERRIES

Investigators: Barney, D. L.
Termination Date: 06/30/2003
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
A three-year study on responses of Vaccinium deliciosum, V. membranaceum, and V. ovalifolium to shade was begun. Germplasm collections were made in Idaho, Montana, and Wyoming with additional germplasm from North America, Asia, and Europe obtained through the USDA-ARS National Clonal Germplasm Repository. Sufficient germplasm is now available at the University of Idaho for the development of improved varieties for all ten Vaccinium species native to the western United States. Eighteen V. membranaceum and one V. ovalifolium genotypes were selected for further evaluation and development, based on plant vigor, precocity, self-fertility, yields, and fruit characteristics. Intra and interspecific crosses were made and baseline data collected on self and cross fertility. An extensive herbarium collection was assembled of the ten western Vaccinium species. Model production systems for commercial management of naturally occurring Vaccinium colonies and field production were developed and tests of the systems begun. Under a USDA-CSREES grant, biochemical profiles of seven large-fruited western Vaccinium species were developed, showing the species to be rich sources of antioxidants, anthocyanins, flavonols, flavanols, and phenolic acids, rivaling and often surpassing domestic highbush and half-high blueberry cultivars. A marketing study was completed and potential products and marketing strategies were identified, as were prospective cooperating growers. Promising genotypes from five native species were cloned and are being multiplied for distribution to cooperating growers, with distributions planned to begin in 2004.

Impact:
Biochemical analyses showed some western Vaccinium species to be rich sources of antioxidants, anthocyanins, flavonols, flavanols, and phenolic acids. Three species have good to excellent prospects for commercial production of fruit for culinary uses and two species have excellent potential as sources of medicinal and dietary supplement products.

6. MANAGEMENT OF RHIZOMANIA DISEASE OF SUGARBEET

Investigators: Gallian, J. J.
Termination Date: 06/30/2003
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
VARIETY TEST. Rhizomania varieties adapted to the Idaho and eastern Oregon growing area were tested at Twin Falls on a field that had been inoculated with rhizomania two years prior. Twenty-seven commercial and experimental rhizomania-resistant varieties plus 4 susceptible commercial check varieties were planted on April 22, 2002, to be tested for root yield and quality. Disease was uniform and moderate throughout the test. All susceptible check varieties showed clear symptoms of rhizomania and there were no differences in root yield and recoverable sugar per acre among the check varieties. The 10 highest resistant varieties in root yield were 10.6 tons/A higher in root yield than the susceptible checks and 2654 lb/A higher in recoverable sugar. GREEN MANURE FOR RHIZOMANIA MANAGEMENT. Oilseed radish (Raphanus sativus) that is used as a trap crop for sugarbeet cyst nematode (Heterodera schachtii) is being tested as a green manure for rhizomania management. Oilseed radish had been planted August 15, 2001, at Twin Falls, Idaho, at two seeding rates of 30 and 60 lbs/A and plowed down November 6, 2001, on a rhizomania infested field in a randomized complete block design with 8 replications and plots 33 x 100 ft. Rhizomania resistant (HM 2984RZ) and susceptible (HM Owyhee) sugarbeet varieties were planted on April 22, 2002, following the green manure treatments. These varieties consistently perform equally under disease-free conditions but in this test the resistant variety was significantly greater than the susceptible in the untreated check treatments by 9.6 tons/A in root yield and 2808 lb/A in recoverable sugar. With green manure treatments, the susceptible variety was higher in both root yield and recoverable sugar per acre in the 60 lb/A seeding rate than the untreated check or the 30 lb/A seeding rate. The resistant variety was higher in recoverable sugar/A in the 60 lb seeding rate than the 30 lb/A rate. In an additional green manure experiment, oilseed radish was planted on August 20, 2002, at Twin Falls, Idaho, disked twice and plowed down on November 7. Resistant and susceptible sugarbeet varieties will be planted in the spring of 2003. Yield and quality differences will be measured and disease ratings taken. The effect of the green manure crop on several soil physical properties will be measured.

Impact:
Using information developed by this project, growers continually reduce loss from rhizomania. Rhizomania resistance continues to be developed and improved by sugarbeet seed companies, and growers are recognizing the need to plant resistant varieties. In addition to planting resistant varieties, growers must use additional management practices to achieve acceptable yields under rhizomania conditions. Data from this project shows that planting a green manure crop can be a valuable practice for improved disease control. Each year there is increasing sugarbeet acreage of oilseed radish being planted by growers for rhizomania management, and it is expected that losses from rhizomania will continue to decrease as these practices are further adopted.

7. BIORATIONAL DISEASE CONTROL

Investigators: Chun, W. W.
Termination Date: 06/30/2003
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Research efforts for biorational disease control has proceeded along three major investigation lines. One involves Pseudomonas corrugata, a bacterial plant pathogen that can cause pith

necrosis only in tomatoes and a few cultivars of pepper. The bacterium's strong antibacterial and antifungal properties can be harnessed to control fungal root diseases on several non-plants such as peas, chickpeas, wheat, lentils, etc. Biological control strains of P. corrugata have been patented (US Patent No. 6,156,560) and deposited with the American Type Collection. Stress selected strains have been developed as a dry talc formulation (US Patent No. 6,383,798) and we are seeking commercial development of this bacterium. Mutants were created from the parental strain 0782-6 using transposon mutagenesis. Four mutants were identified that were not pathogenic on tomatoes but still retained their antifungal and antibacterial activities. Three of these mutants were identical to the parental strain in their biological control ability for Aphanomyces root rot of peas. One mutant had increased antifungal and antibacterial activities. This resulted in greater reduction of disease severity, greater plant growth, and higher yields in replicated field trials. Future work will include the creation and testing of pathogenicity gene deletion or interrupted mutants for biological control ability. The second line of investigation involves the identification of bioactive metabolites from basidiomycetes. Ganoderma lucidium, the chicken of the woods fungus, was shown to have strong helminthocidal activity against plant parasitic nematodes. The material was also shown to be active against fungi. This is significant as it may lead to a new class of compounds for agricultural use. The third line of investigation has shown that extracellular polysaccharide production by Xanthomonas campestris pv. campestris is essential for pathogenicity. Research results have thus shown that different regulatory signals and mechanisms are involved for epiphytic survival and for pathogenicity and that these are externally regulated. This may eventually lead to a new approach to managing plant disease by disrupting the initial stages of plant contact and epiphytic survival.

Impact:
A new biological control agent was developed that controls several plant root pathogens, thereby reducing the need for multiple chemical pesticide application reducing grower cost resulting in increased profits. A new product was identified that can be used to control nematodes, pathogens that have a limited number of management or treatment methods and potentially could prove to be a replacement for the loss of methyl bromide.

8. BIOLOGY AND MANAGEMENT OF INSECT PESTS OF WHEAT IN IDAHO

Investigators: Bosque-Perez, N. A.
Termination Date: 06/30/2003
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Research efforts continue to focus on two main areas: 1) Biology and management of wheat insects and 2) Host plant - virus - vector interactions. Field trials were repeated in 2002 to evaluate the incidence of Hessian fly under no-till (NT) and conventional till (CT) practices. The only significant variation in egg density between the tillage treatments occurred in late May, when more eggs were found on CT than NT plots. Significant differences in mean number of Hessian fly puparia per plant were observed during the last two sampling periods in July, when CT plots had higher numbers of puparia per plant than NT plots. NT plots had a lower percentage of infested plants than CT throughout the growing season in 2002. Field trials also demonstrated that the H3 gene continues to exhibit effectiveness in controlling Hessian fly in the field. Evaluation of wheat breeding lines for resistance to Hessian fly continues as part of our

collaboration with wheat breeders. Focus continues to be on the H3, H25 and H26 resistance genes. Field trials also assessed the species composition and abundance of parasitoids of Hessian fly in northern Idaho and the abundance, richness, and community structure and composition of ground-dwelling arthropods in response to different crop and tillage treatments. Studies on host plant - virus - vector interactions included experiments to measure the effect of barley yellow dwarf virus acquisition access periods or inoculation access periods on transgenic wheat and susceptible wheat cultivars.

Impact:
This collaborative multidisciplinary research has accelerated development of cereal varieties with genetic resistance to important insect pests.

9. FACTORS INFLUENCING THE ACQUISITION, TRANSMISSION, AND SPREAD OF PLRV BY APHID VECTORS

Investigators: Mowry, T. M.
Termination Date: 06/30/2003
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
In laboratory experiments, six insecticides were tested for efficacy in killing green peach aphids and their ability to limit Potato Leaf Roll Virus (PLRV) acquisition by non-viruliferous aphids and PLRV inoculation by viruliferous aphids. These insecticides were esfenvalerate, imidacloprid, methamidophos, oxamyl, pymetrozine, and thiamethoxam. Esfenvalerate was a relatively poor aphicide, but exhibited anti-feedant properties that resulted in significant reductions in aphid acquisition and inoculation of PLRV. Methamidophos and oxamyl had little effect on PLRV acquisition and no effect on inoculation, even though they were very good aphicides. Imidacloprid and thiamethoxam were excellent aphicides and, especially imidacloprid, significantly reduced PLRV transmission. Pymetrozine was a very good aphicide and was the most effective at limiting PLRV transmission. Based on these laboratory results, field experiments were begun to determine if certain combinations of insecticides would not only control green peach aphids in the potato crop, but also reduce the spread of PLRV. Green peach aphid degree-days corresponding to peak seasonal population development were used to trigger four foliar insecticide applications consisting of alternating combinations of imidacloprid, pymetrozine, and/or thiamethoxam. For comparison, the current Pacific Northwest Green Peach Aphid Management Plan was included as an additional treatment. The Plan calls for a systemic insecticide at planting and application of foliar insecticides if routine leaf samples revealed that aphids exceeded the recommended threshold. Experiments in two locations revealed that the insecticide combinations triggered by accumulated degree-days controlled green peach aphids as well as strict adherence to the Management Plan. The amount of PLRV spread for each of the treatments has not yet been determined. These results indicated that growers may be able to use green peach aphid degree-days for making insecticide application decisions rather than thresholds based on intensive, season-long field sampling. In addition, it appears that reducing the total amount of insecticide applied during the season does not jeopardize aphid control if applications are made when aphid populations are most likely to develop. Preliminary laboratory experiments were conducted to better understand the relationship between PLRV, the aphid vector, and the plant host relative to virus transmission mechanisms. In routine experiments, it

has been observed that not all aphids transmit PLRV, even though they are from clonal colonies. Green peach aphids were allowed to acquire PLRV and were then sequentially transferred through a series of five transmission indicator plants. Not all indicator plants became infected with PLRV as indicated by ELISA testing, but at least three plants in every sequence became infected. This showed clearly that 100% of the aphids had acquired PLRV and were competent to transmit the virus. Therefore, vector incompetence was not the reason that all plants did not become infected. It appears there are aphid behavioral and/or plant refractoriness factors associated with failure to transmit PLRV.

Impact:
First year experiments support the idea that it may be possible to completely revise the green peach aphid management plan for PLRV control. Use of insecticides having feeding behavior effects with application accurately timed via degree-day triggers may reduce the cost and environmental impact of more intensive insecticide management strategies. In addition, growers can be freed of labor-intensive field sampling and the vagaries of trying to keep aphid densities below empirical threshold levels.

10. A CHAPERONE CONTROLLING MOTILITY AND DEVELOPMENT OF MYXOCOCCUS xanthus

Investigators: Hartzell, P. L.
Termination Date: 06/30/2003
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
We continue to work on AglZ, a novel coiled-coil protein that we have discovered in Myxococcus xanthus. The original DNA fragment carrying the aglZ gene was recovered from the yeast two-hybrid library as a pGAD clone that expressed a protein that interacted with the GAL4 binding domain protein fused to MglA, a small GTPase. When recombined onto the chromosome of M. xanthus, single cell (A motility) was abolished. Because only a portion of the aglZ gene was present in the pGAD clone, we used the aglZ fragment as probe against a library carrying M. xanthus chromosomal DNA and a 6 kb fragment containing the 5'- and 3'-ends of the aglZ gene was obtained. Sequence shows that aglZ is predicted to encode a 150,000 dalton protein. The N-terminal 20% of the protein shares identity with response regulator proteins while the remaining (80%) of the protein contains multiple stretches of residues predicted to form coiled-coil structures. The aglZ gene has been expressed in E. coli and shown to yield the expected 150,000 dalton polypeptide. AglZ has been purified and preliminary analysis indicates that the protein can form a filament structure. To determine the cellular location and filament-forming capability of AglZ in M. xanthus, we have fused the gene encoding GFP (green fluorescent protein) to the 5' end of aglZ. Two different versions of gfp were used in this study. The EGFP (enhanced GFP) plasmid carries a version of gfp that has codon usage that is optimal for human cell expression and produces a protein with bright fluorescence. However, fusions that carry this version of gfp are not always expressed well in GC-rich organisms such as M. xanthus. Therefore, we recently discovered another version of gfp that was synthesized by a German company who modified the codon usage for optimal expression in organisms with GC-rich DNA. We have recently used this new gfp to generate a second fusion with aglZ. Both fusion constructs have been introduced into M. xanthus and we are preparing to use fluorescence

microscopy to determine the cellular location of the AglZ protein and to determine if it forms a filament in vivo. To make a markerless deletion mutant, an internal portion of the aglZ gene was removed and the 5' and 3' ends of the gene were ligated. Truncated aglZ was then cloned into pBJ113, a plasmid that contains the gene conferring resistance to kanamycin and the galK gene for counterselection. The pBJ113aglZ constructs have been introduced into M. xanthus and at present we are selecting for loss of the vector by growing cells in the presence of galactose. Cells expressing the galK gene produce galactokinase which converts galactose to phosphogalactose, which is toxic. Addition of galactose to the growth medium stimulates loss of the integrated vector. On occasion, recombination and loss of the vector will remove the wild-type copy of the aglZ gene, leaving the truncated aglZ behind. We are presently scoring mutants that have lost the galK gene for those which exhibit a phenotype consistent with the loss of the wild-type aglZ.

Impact:
The work described here is part of a larger goal to understand a complex signal transduction pathway that allows a single cell to coordinate two distinct motility systems that operate simultaneously. The finding that a coiled-coil protein that resembles eukaryotic golgin and myosin proteins is involved in bacterial motility is an important breakthrough. Our findings support the idea that AglZ, the coiled coil protein, interacts with MglA, a Ras-like GTPase to control motility. We have also shown that MglA interacts with a tyrosine kinase of the STY kinase family, the first protein of this family to be identified in a bacterium. These data hint that early prokaryotic systems for movement were early precursors for the complex molecular motor used in higher organisms.

11. RESIDUE AND ROTATION IN A SMALL GRAIN PULSE AND BRASSICA CROPPING SYSTEM

Investigators: Guy, S. O.
Termination Date: 06/30/2004
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Field studies in 2002 included no tillage (NT) variety evaluations and sister variety evaluations conducted under conventional tillage (CT) management. Due to genotype x environment interactions common to variety evaluations, this does not allow investigation of the interaction of variety with tillage systems. A study to investigate the tillage x variety interaction was initiated in 2000 as a long-term study to run at least six years. Three crops are investigated and are grown in rotation, dry pea, wheat, spring cereal. There were no differences in yield between CT and NT for any of the three crops. However, there were differences between varieties and there was an interaction of tillage and variety in dry pea. Pest control was good across the experiment except for meadow vole damage to the winter wheat that was greater in NT. There were no differences between tillage for stand establishment. Grain seed weights and test weights were higher in NT and reflect that the plants stayed green longer in NT for a longer grain filling period. Plant height and biomass were lower in NT than CT and is a result of cooler early growing environment in NT that reduces growth. The bulk areas of the experiment were used to collect data on: beneficial and harmful insect differences between tillage treatments; soil physical, biological, and moisture differences; and disease interactions. Another study evaluating date of planting and nitrogen fertility effects on yellow mustard was conducted and confirmed results from earlier

studies that early planting is important for yield and nitrogen management is important for optimum yield and quality.

Impact:
Information about no-till management helps growers adopt and successfully practice no-till farming. This reduces erosion and farmers use less fuel to farm per acre. When growers grow the best adapted variety for their growing conditions, they are more profitable. Management information about yellow mustard allows profitable production of an alternative crop in the Pacific Northwest.

12. INTEGRATED MANAGEMENT STRATEGIES FOR ARTHROPOD PESTS OF HOP IN IDAHO

Investigators: Barbour, J. D.
Termination Date: 06/30/2004
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Experiments using a Y-tube olfactometer established that spider mite damaged hop produces volatiles that are attractive to G. occidentalis and/or N. fallacis, two predatory mites that prey on T. urticae. The spatial and temporal epidemiology of hop powdery mildew in Idaho hops yards was examined in order to test an infection risk forecasting model for hop powdery mildew for utility in timing pesticide applications for this pest.

Impact:
Data from these studies will provide 1) a better understanding of the factors affecting predatory mite effectivenss in hop and potentially other crop systems. 2) information allowing growers to more effectively manage hop powdery mildew in Idaho hop yards.

13. BROADENING GENETIC BASE AND DEVELOPING HIGH YIELDING EARLY MATURING BEAN WITH RESISTANCE TO DISEASES

Investigators: Singh, S. P.
Termination Date: 06/30/2004
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Two advanced breeding lines of great northern market class were evaluated for their reaction to anthracnose, bean common mosaic virus (BCMV), common bacterial blight, Fusarium root rot, halo blight, rust, white mold, drought, and low soil zinc deficiency. They were also tested for seed yield, seed weight, maturity, and plant type in Idaho, and in the Western Regional Bean Trial (WRBT) and North American Cooperative Dry Bean Nursery (CDBN). None of the lines were superior to previously released great northern (UI 425 and UI 465) cultivars. Nonetheless, because of relatively large seed size and the protected I gene resistance to BCMV, and resistance to halo blight and rust; and moderate tolerance to drought, low soil zinc deficiency, and continual bean cropping, UI98-209G was selected for registration and release as a germplasm. This line

was tested as 98:209G between 1999 and 2002. The F1 hybrids of two multiple-parent interracial crosses were grown at Parma Research & Extension Center. Plants within each cross were harvested individually to develop F1-derived families for further evaluation and selection. Moreover, 48 F1-derived F3 and F4 families from three multiple-parent interracial populations were evaluated for their overall agronomic performance. The root knot nematode (Meloidogyne chitwoodi and M. hapla) resistant tropical carioca bean cultivar Apore was crossed with susceptible pinto 'Mesa'. The F1 was backcrossed on both parents and allowed to produce F1 seeds.

14. VARIABILITY AND EVOLUTION OF POTYVIRUSES

Investigators: Berger, P. H.
Termination Date: 06/30/2004
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Work is proceeding to identify, characterize and determine evolutionary relationships of potyviruses. The Sunflower mosaic virus was characterized during the reporting period. Strains of Potato virus Y (PVY)that are either novel or were previously exotic to the US are in the process of being characterized. A reverse transcription-polymerase chain reaction-RFLP assay was modified from existing protocols to permit identification of these new isolates. Additional information on nucleotide sequence of these isolates was also obtained. The N strain (PVYN) was identified, as were isolates resembling European strains of NTN (PVYNTN). Isolates and strains identified as PVYNTN are, in fact, the result of recombination between PVYO (the common strain) and PVYN. PVYNTN is of particular concern because it is an international quarantine pest, and causes loss of quality of potatoes from infected plants as well as loss of yield. Furthermore, two additional isolates were identified. One of these isolates has sequences that are similar to PVYNTN , but these sequences are phylogenetically distinct from sequences of other strains and isolates. Another isolate, which may be novel, also has PVYNTN-related sequences, but recombination has resulted in a virus whose 3'-end has PVYO sequences. PVYO sequences in this virus include the coat protein region, which means that it will appear to PVYO on the basis of serological tests commonly used by state potato seed certification organizations. Since low levels of PVYO are permitted in seed, particularly in more advanced field generations, this recombinant virus will likely continue to be propagated in our seed systems. This isolate, as well as the other isolates new to the US represent a significant threat to the US potato industry. Work is underway to more thoroughly characterize these isolates of PVY biologically and molecularly, to obtain improved diagnostic reagents and procedures, and to obtain better information on the distribution and prevalence of PVY in US potatoes.

Impact:
Strains of Potato virus Y (PVY) that were previously unknown in the US have been identified. Results from this work have provided improved diagnostic tools capable of identifying strains and isolates of PVY. These tools represent an intermediate step towards obtaining high-throughput tools that can be utilized by state potato seed certification organizations. Complete characterization of these strains and isolates will provide definitive information as to their identity and may permit identification as to the source of these viruses.

15. DEVELOPING MORE EFFECTIVE WEED MANAGEMENT SYSTEMS FOR SUGARBEET

Investigators: Morishita, D. W.
Termination Date: 06/30/2004
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Weed control studies were conducted in sugar beets to evaluate dimethenamid with conventional rates of registered herbicides, broadleaf weed control with micro and conventional rates, compare Progress and Betamix formulations for weed control, application timing of postemergence weed control, preemergence tank mix combinations of ethofumesate and pyrazon for weed control, and volunteer potato control with registered and non registered herbicides. Dimethenamid effectively controlled later emerging weeds, but did not improve weed control compared to currently registered products. Micro herbicide rates effectively controlled weeds compared to conventional rates, with the exception of kochia. Micro rates did not satisfactorily control kochia. Comparisons of new Progress and Betamix formulations to originals indicate no increased injury risk. Preemergence tank mix applications of ethofumesate plus pyrazon controlled weeds better than either product alone at all of the tank mix rates. Some injury was observed at higher tank mix rates used. Volunteer potato control ranged from 23 to 100%. However, sugar beet yields were equal between the poorest volunteer potato control treatment (Progress + UpBeet + Stinger applied 3 times) and the best treatment (Roundup wick applied).

Impact:
With proper herbicide application timing and rate, sugar beet growers can effectively control most weeds in sugar beets with currently available herbicides. The most challenging task to growers is being able to make the herbicide applications in a timely manner, due to weather constraints.

16. SEED POTATO QUALITY IMPROVEMENT

Investigators: Nolte, P.
Termination Date: 06/30/2004
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Research comparing the performance of cut potato seed to that of uncut seed has been ongoing for the last eight years. Over the eight-year period, research indicates that use of whole seed did not result in an increase in yield over cut seed, when cut seed was treated with seed treatment fungicides fludioxanil or thiophanate-methylplus mancozeb. Whole seed actually had higher levels of seed decay and stem/stolon canker caused by Rhizoctonia solani than the cut and treated seed. This research indicates that seed treatment may be required on whole seed if seed decay conditions are favorable or Rhizoctonia is a concern.

Impact:
Potato producers will better understand the advantages and disadvantages of whole seed vs. cut seed for effective management of their production system(s). The advantage of a chemical treatment for Rhizoctonia control in whole seed, for example, will be more heavily emphasized.

17. PLANT REGENERATION TECHNIQUES AND GENETIC TRANSFORMATION OF LANDSCAPE AND FLORAL PLANTS

Investigators: Tripepi, R. R.
Termination Date: 06/30/2004
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
A two-tiered approach for attempting genetic engineering of Rhododendron catawbiense cultivars ('Album', 'America', and 'Cunningham's White', and 'Joe Paterno') and Rhododendron 'PJM' was used this year, and progress has been made on transferring foreign genes into two rhododendron cultivars. The first genetic engineering technique involved Agrobacterium-mediated transformation of the five rhododendron cultivars. We obtained genetically modified Agrobacterium LBA4404 from Washington State University. Standard procedures developed earlier for inoculations and handling of the inoculated explants were used. The shoot regeneration medium contained 30 mg/liter kanamycin in MS medium. The LBA4404 strain contained the plasmid pBI121, which contained a gene for resistance to kanamycin (NPTII) and a gene for beta-glucuronidase (GUS). Acetosyringone was also used in the inoculation and co-cultivation media in this study. Ten weeks after inoculation with LBA4404, a few 'America' leaf explants formed shoots. Five shoots formed on three leaf explants out of 29 left in the study. 'Album', 'Cunningham's White', 'Joe Paterno' and 'PJM' leaf explants failed to form shoots after ten weeks. After 22 weeks, regenerated 'America' shoots were transferred to medium containing either 50 or 75 mg/liter kanamycin. All shoots continued to grow on these media. Six months after the experiment began a few leaves from regenerated 'America' microshoots grown on kanamycin-supplemented medium expressed GUS if the leaves were roughly handled. PCR analyses need to be completed. The second approach to genetic transformation of rhododendron involved using the biolistic DNA-delivery system. The same rhododendron species and cultivars were also used. The plasmid pCAMBIA2301 was used in experiments and contained the NPTII gene and a gene for GUS. This plasmid was cut with restriction enzymes to make the DNA linear and then used in the gene gun. Leaf explants were assayed for GUS two days after shooting. Leaf explants from 'PJM' microshoots responded the best and were used in most of the biolistic studies, but leaves from 'Cunningham's White' and 'America' transiently expressed the GUS gene on only several occasions. Making the plasmid DNA linear seemed to improve transient GUS expression. In a series of experiments, the amount of DNA to apply per bombardment, explant culture time (days) before bombardment, dark pre-treatment of leaf explants, and osmotic pre-conditioning of the explants were tested for their effects on transient GUS expression. A DNA concentration of 2 micrograms per bombardment was the most effective for transient GUS expression by 'PJM' leaves. Leaves cultured for 6 to 12 days before bombardment had the highest levels of transient GUS expression. Explants exposed to the dark for 3 or 6 days before bombardment had higher levels of transient GUS expression than those exposed to the usual light treatment during culture. Incubating 'PJM' leaf explants on sucrose-free medium for 2 days before and after bombardment resulted in higher levels of transient GUS expression compared to leaves cultured on sucrose-supplemented medium.

Impact:
This research is the first to report putative genetic transformation of rhododendron by directly using leaf explants rather than stem sections or 'thickened' stem, petiole or leaf segments when using a strain of Agrobacterium tumefaciens (LBA 4404) as reported by other researchers. The techniques developed in our study could enable researchers who use Agrobacterium to transform particular rhododendron cultivars more easily and reliably than the other successful methods used to date.

18. DEVELOPING IMPROVED SOFT WHITE WINTER WHEAT CULTIVARS FOR THE PACIFIC NORTHWEST

Investigators: Zemetra, R. S.
Termination Date: 06/30/2004
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Two advanced lines are currently being considered for release, 91-34302A and 91-20503A. 91-34302A, tentatively called 'Simon', is a soft white winter wheat with Pseudocercosporella foot rot resistance. 91-20503A, tentatively called 'Dune' is a short, early, soft white winter wheat with excellent yield potential. Wheat lines in three soft white winter wheat backgrounds carrying the gene for imazamox resistance have been produced and are undergoing evaluation in the field. Germplasm with resistance/tolerance to Cephalosporium stripe has been incorporated into the breeding program. Research has been initiated to develop markers for the C. stripe resistance and for the foot rot resistance gene Pch1. Evaluation of methods to simultaneously screen for winter-hardiness and foot rot resistance continue in the greenhouse. The gene CCR1 from wheat that is involved in the lignin biosynthesis pathway has been cloned, put into a construct and placed into wheat via particle bombardment in the sense and anti-sense format to down regulate lignin synthesis in wheat straw.

Impact:
The development of soft white winter wheat cultivars with improved agronomic performance, disease resistance and end-use quality will result in improved profitability for the wheat producers in the Pacific Northwest. The development of adapted herbicide resistant wheat cultivars will aid growers in controlling weeds such as jointed goatgrass. Wheat with reduced lignin content in the straw could lead to the use of the straw in the production of bioproducts supplying the producer with another income source from his/her wheat field.

19. DEVELOPING SUPERIOR OILSEED AND MUSTARD CULTIVARS FOR BRASSICACEAE

Investigators: Brown, J.
Termination Date: 06/30/2004
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Acreage of `IdaGold' condiment yellow mustard continued to increase with over 25,000 acres in the region. An additional 100 acres of certified seed was produced. `Pacific Gold', oriental

mustard, was grown commercially for the first time and `Athena', winter canola, was planted commercially for the first time in fall of 2002. Foundation seed was produced for `Clearwater' (spring canola) and `Impact' (spring rapeseed), the first two herbicide (Raptor) resistant cultivars developed at the University of Idaho. The first year of field testing IdaGold and Pacific Gold seed meal as an alternative to synthetic soil fumigants was completed. Results showed that IdaGold meal (at 1 ton/acre) controlled over 99% of all grassy and broad-leaf weeds while Pacific Gold (at that rate) controlled 100% of fungus gnats. Further large-scale testing will continue in 2003. A study was initiated to examine the inheritance of low polyunsaturated oil in Brassica species. Insect resistant breeding lines from canola x yellow mustard hybrids were retested and found to be heritable.

Impact:
The aim of this breeding program has been to offer growers in the region greater flexibility on choice of crop and cropping rotation. Availability of IdaGold and Pacific Gold mustard has offered Pacific Northwest growers more crop rotation benefits and options and helped increase export potential. Similarly, Athena winter canola is beginning to have impact, particularly if this cultivar can be planted late in the season and survive winter. The potential for developing high glucosinolate intergeneric hybrids remains strong and could provide an alternative to highly toxic synthetic soil fumigation.

20. GENETIC MANIPULATION OF SWEET CORN QUALITY AND STRESS RESISTANCE

Investigators: Mohan, S. K.
Termination Date: 09/30/2004
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Fourteen mixtures of fungicides and insecticides applied to seed of two sweet corn varieties, 277A (sh2) and July Gold (se), were evaluated at 24 locations throughout the U.S., and one location in Japan. Final stand counts of 277A in untreated check ranged from 17% to 82%, and those from the best treatment ranged from 34% to 94% among the various locations. With July Gold, the final stand counts of untreated check ranged from 0.5% to 60%, and of the best treatment from 7% to 86%, among the locations. None of the fungicides or insecticides showed phytotoxicity. Three seedlots of sweet corn variety 710 (sh2) were treated with acidic electrolyzed water for 30 minutes to evaluate its potential to reduce seedborne pathogens. The treatment did not affect germination, field emergence, or blight incidence. There was significant reduction but not complete elimination of the seedborne Fusarium and Penicillium propagules. Fifteen seed treatments were evaluated for efficacy against head smut using a susceptible sweet corn hybrid. At one location, treatments containing carboxin or triadimenol or tebuconazole or difenoconazole showed less infection by head smut than the untreated check.

Impact:
Performance data from multiple locations with different fungicide and insecticide treatments using two genotypes of sweet corn will provide treatment options. Efficacy and phytotoxicity data will help support registration of promising products for future use.

21. SEED POTATO PERFORMANCE

Investigators: Olsen, N.
Termination Date: 06/30/2004
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:

Plant growth and weather information for the cultivars 'Russet Burbank', 'Ranger Russet', 'Umatilla Russet', 'Shepody', and 'Russet Norkotah' were monitored in the seed-growing areas of Idaho in 1999, 2000, and 2001. Accumulated air and soil heat units from tuberization to harvest were used to determine temperature exposure and impact of differing seed growing seasons on seed performance. In the 2001 seed growing season, seed tubers accumulated similar heat units as the 2000 season, although the accumulation tended to be earlier in the 2001 growing season. The influence of the different growing seasons was evident in seed sprouting and response to seed storage treatments. At harvest, seed tubers were transported to the Kimberly Potato Storage Facility and placed in storage. Seed storage treatments included: a) 3.3C until planting, b) 3.3C followed by 1 month at 7.2C prior to planting, and c) 3.3C followed by 2 weeks at 15.6C prior to planting. More advanced sprouting was seen in the 3.3C and 15.6C treatment (1-8 cm) and the least with seed stored at 3.3C (0.1-2 cm) prior to planting. Seed tubers stored at 3.3C were evaluated throughout the storage season for dormancy break and sprout development. All cultivars, except 'Russet Burbank' and 'Shepody', initiated sprouting and reached 80% peeping (dormancy break) later in the 01/02 season compared to the previous season (00/01). The seed growing season appears to have influenced dormancy break, although it cannot be explained solely by accumulated heat units. After planting the seed, it was evident that aging 'Russet Burbank' and 'Ranger Russet' seed did influence emergence, but did not alter aboveground stem numbers. 'Umatilla Russet' was the only cultivar in 2002 that did not exhibit typical physiological age characteristics in the field due to the storage treatments for there was no difference in emergence or aboveground stem numbers. 'Shepody' and 'Russet Norkotah' responded to one or both elevated seed storage temperatures by exhibiting an increased rate of emergence and increased aboveground stem numbers. 'Norkotah' tuber size 114-169 g yields increased due to more advanced aging treatments while the remaining size profiles and yields were not altered. After evaluating three years of data, it appears 'Ranger Russet' will require longer and/or higher seed storage temperatures to affect stem number, size profile and yield. 'Shepody' showed an increase in yield of tubers sized 114-169g and 170-283 g in the 3.3C and 15.6C treatment. This would be a benefit in the economic return for the production of the cultivar. 'Russet Burbank' and 'Umatilla Russet' size profiles and yields were not influenced by seed age treatments in 2002. In general for the 2002 season, although sprout development and stem numbers were elevated due to physiological aging by the seed storage treatments, those affects on yield and size profile were minimal. In some years, early growth due to aging would be beneficial especially if final yield and quality were not affected. 'Shepody' and 'Russet Norkotah', two early harvested cultivars, appear to be more sensitive to the effects of seed aging.

Impact:

This study has demonstrated that cultivars respond differently to seed storage treatments and provides information on how to manage seed for early growth, yields and yield profiles. It also indicates the lessened impact of seed aging on final yield and tuber size for long-season cultivars.

The seasonal affect on seed tuber physiology and age impacts how the seed responds to storage conditions and ultimate field performance.

22. ENVIRONMENTAL EFFECTS ON FORAGE QUALITY AND TESTING FOR THE DIFFERENCES

Investigators: Shewmaker, G. E.
Termination Date: 06/30/2004
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
This completes the third year for data gathering, some sites have 4 years data. Studies will be continued next year. Forage (alfalfa) yield and quality functions can be developed from these data for each site and correlated with the AgriMet weather data. Cooperation with other states is being developed in order to perform chemical forage quality determination and to share samples for Near-Infrared Reflectance Spectrophotometer calibration. This will allow more rapid and cost effective analysis of additional samples.

Impact:
This will be a decision aide for producers to evaluate whether their goal will be for high quality, high yield, or to optimize both yield and quality of forage, given their management options, markets, and weather. Producers will be able to better determine profitability for forage production, and forage feeders will be better able to predict animal performance.

23. CHARACTERIZATION OF THE ACTIVITIES OF PLANT GROWTH PROMOTING STREPTOMYCES IN THE RHIZOSPHERE

Investigators: Crawford, D. L.
Termination Date: 06/30/2005
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Streptomyces are root-colonizing soil bacteria. Some rhizosphere colonizing species are plant growth promoting rhizobacteria (PGPR) that enhance plant growth and protect roots from phytopathogens, particularly fungi. We study the plant growth enhancing properties of these Streptomyces, focusing on the interactions of Streptomyces lydicus strain WYEC108 with pea and soybean. This strain enhances growth of peas in part by colonizing the root nodules. Our most recent work shows that S. lydicus enhances plant growth by colonizing the surface layers of the nodules and aiding the plant in assimilating iron into the nodules and then into bacteroids within them. The Streptomyces appear to make hydroxamate type siderophores which are involved in sequestering iron and in some as yet unknown way, transferring it to the bacteroids. This is a new phenomenon of plant growth enhancement not reported previously. Evidence also suggests that this type of plant growth enhancement occurs in nature, as evidenced by confirmed colonization of legume nodules by naturally occurring actinomycetes within randomly examined samples of peas taken from fields in the Pacific Northwest. In addition to siderophores, production of phytohormones, solubilization of phosphates or other minerals, and/or nitrogen fixation may be involved in plant growth promotion by these Streptomyces. Strain WYEC108

also produces an antifungal and several anti-Gram positive antibiotics when growing in the rhizosphere. The antifungal actability protects plants against invasion by fungal root pathogens. Studies of the structures, biosynthetic pathways and genetic regulation of these antibiotics are ongoing. We continue to also study other rhizosphere-colonizing actinomycetes. All are Streptomyces strains. In particular, we are characterizing strains isolated from the roots of desert shrubs such as sagebrush (Artemesia tridentata and related species). These Streptomyces are producers of a range of antifungal antibiotics, some of which appear to be novel. Since there is a significant need for new antifungal antibiotics for use in human and veterinary medicine, we are pursuing the purification and identification of these novel compounds. These antibiotics are effective against phytopathogenic fungi as well as animal and human fungal pathogens such as yeasts (Candida albicans). Some of our stains also promote plant growth (e.g., vegetables, legumes) in the absence of pathogens, and growth promotion is not related to their antibiotic producing abilities. Our goal is develop selected of the strains as biocontrol agents, PGPR, and as producers of novel antibiotics. Finally, in studies with sagebrush root exudates, we have shown recently that the production of antibiotics by rhizosphere isolates of Streptomyces is induced by soluble metabolites present within the rhizosphere. Certain Streptomyces do not produce antibiotics in laboratory medium unless root exudates are added as elicitors/inducers. In other strains, elicitors enhance antibiotic production. The significance of this previously unobserved phenomenon is under investigation.

Impact:
The focus of our research is on the interactions between rhizosphere colonizing Streptomyces and their plant hosts, and on developing these microbes into useful products for improving crop yields. Another objective is to isolate and develop new antifungal antibiotics for veterinary and pharmaceutical use. One commercial product employing S. lydicus WYEC108 for promotion of plant growth is already commercially available.

24. BIOLOGICALLY BASED MANAGEMENT OF THE CABBAGE SEEDPOD WEEVIL ASSOCIATED WITH OILSEED RAPE IN IDAHO

Investigators: McCaffrey, J. P.
Termination Date: 06/30/2005
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
The cabbage seedpod weevil, Ceutorhynchus obstrictus (Marsham) (Coleoptera: Curculionidae), is a major pest of oilseed rape in North America and Europe. To improve management and procedures for assessing diapause and post-diapause needs of this insect, we developed and validated degree-day models (base temperature of 10 degrees C) for predicting C. obstrictus adult weevil emergence and post-diapause flight, reproductive activity, and development in winter oilseed rape. Seasonal changes in gender ratios in field samples of C. obstrictus in winter oilseed rape; and methods to enhance oviposition of laboratory-preconditioned C. obstrictus in cage experiments by addressing the effect of various male to female ratios on oviposition were also addressed. Four degree-day models were developed and validated for C. obstrictus in winter oilseed rape that predicted adult weevil post-diapause emergence in northern Idaho, eastern Washington, and northeastern Oregon. The models described cumulative percent adult weevil emergence as a function of cumulative degree-days. In addition, the field phenology of

oviposition, ovariole development, and gender ratios was assessed. Finally, three oviposition experiments, two with laboratory-overwintered post-diapausal weevils and one with field-preconditioned post-diapausal weevils was performed in the laboratory to determine the effects of gender ratios on the fecundity of C. obstrictus in small cage experiments. Two of the four models had good fit to the data. Validation of the model, based on a January 1 biofix, resulted in approximately 3% of data points falling outside the 95% confidence interval. Validation of the model, based on a first flower biofix, resulted in approximately 1% of data points falling outside the 95% confidence interval. The model based on the biologically determined, first flower biofix is a superior model. In 2000 and 2001, first oviposition occurred between 40 and 162 cumulative DD50 based on the first flower biofix and the dates of peak oviposition were variable. The female weevils that immigrated into the field sites were sexually immature and ovariole development was complete between 40 and 247 cumulative DD50 based on first flower biofix. The onset of oviposition occurred before all females had completed ovariole development. Interestingly, weevils that initially migrated into the field sites were male and weevil populations were predominantly male at all of the field sites, although the percentage of females increased over time. The oviposition experiments utilizing laboratory-overwintered, post-diapausal weevils had a general trend of increased oviposition with an increase in the number of males per females per cage, suggesting that more males insured mating. The oviposition experiments employing the field-preconditioned, post-diapausal weevils displayed a trend of decreased oviposition with an increase of the number of males per females per cage. Apparently, the males disrupted the females and reduced oviposition. Oviposition was greater in the field-preconditioned weevils than the laboratory-overwintered weevils. Oviposition increased with time in all treatments.

Impact:
This research has led to enhancements in our ability to predict weevil population development over the season using degree-day models and simple weather data. Also we have developed better methods to maintain this insect in the laboratory where further studies on its biology, ecology, and behavior are being conducted.

25. MANAGING HERBICIDE-RESISTANT PLANTS IN DIRECT-SEED DRY LAND WHEAT PRODUCTION SYSTEMS IN THE PACIFIC NORTHWEST

Investigators: Thill, D. C.
Termination Date: 06/30/2005
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Imidazolinone resistant spring canola, spring wheat, and facultative winter wheat, Fidel, were direct-seeded in the second year of the rotation study. Imazamox was applied in the herbicide resistant treatment, and typically prescribed herbicides for the species present were applied in the standard herbicide treatment. Weeds were counted before and after application and total plant biomass by species at wheat heading was taken from three 0.5 sq m areas within each experimental unit. Crops were harvested at maturity to determine canola seed and wheat grain yield and wheat test weight. Total weed biomass was 10, 10, and 1.5 g/sq m with standard treatments and 2, 0.4, and 0.5 g/sq m with the resistant treatments for canola, Fidel wheat, and spring wheat, respectively. Crop seed yield was similar between herbicide treatments and rotations in 2002. Final analysis will be in 2006 after three cycles of the 2-year and two cycles of

the 3-year rotations. In the herbicide resistant enrichment study, Madsen winter wheat was direct seeded into pea stubble October 2001. Three plots were treated with the group two herbicides thifensulfuron/tribenuron + flucarbazone (on year) and two plots and the check plot were treated with bromoxynil + diclofop (non-group two). Wheat grain yield ranged from 5239 to 6130 kg/ha. Herbicide resistant weed biotype selection will be determined at the end of the study in 2005. Field experiments were conducted in OR, ID, and WA to determine the potential for pollen-mediated gene flow between winter wheat cultivars. Each experiment was designed as a Nelder wheel with 16 equally spaced rays extending away from a central pollen source. The central pollen source was a 0.17 ha plot of blue-aleurone wheat. Each of the 16 rays was 45 m in length and contained two rows each of an early- and late-flowering soft white wheat cultivar. Samples were collected at 1.8 m intervals along each ray and the grain was examined to identify blue seeds, which indicated successful hybridization with the pollen source. At the WA location, 17 out of 832 samples examined had at least one blue seed. The maximum distance at which gene flow (0.08% of the seeds examined) was observed was 22 m from the pollen source. At the OR location, 66 out of 832 samples had at least one blue seed. The maximum distance at which gene flow (0.08%) was observed was 42 m from the pollen source. At the OR location, one ray had blue seeds in 24 out of 52 samples for an estimated 0.02% of the seeds along the ray arising from cross-pollination. This research is being repeated at two additional sites in the 2002-03 growing season. The preliminary data suggest that pollen mediated gene flow in winter wheat can occur to a distance of at least 42 m. Experiments established in spring 2000 and 2001 near Moscow, ID at the University of Idaho Parker Research Farm and near Ralston, WA at the USDA Ralston Direct Seed Project site to evaluate alternatives to traditional glyphosate treatments for control of volunteer herbicide resistant crops were completed in 2001. An extension publication will be available in 2003

Impact:
Imidazolinone-resistant winter wheat will soon be available to growers in the United States. Imazamox herbicide applied to imidazolinone-resistant wheat provides growers with an unprecedented opportunity to selectively control some of their most troublesome grass weeds such as jointed goatgrass, downy brome, wild oat, and Italian ryegrass. However, many other acetolactate synthase (ALS) inhibiting herbicides (group 2) already are used extensively in wheat-based cropping systems, because they affordably and effectively control many important weed species. Imazamox applied to imidazolinone-resistant wheat will increase group 2 herbicide use, especially in crop rotations where winter wheat is grown frequently. Overuse of this technology likely will result in selection of herbicide resistant weed populations in a relatively short time period, as has occurred previously for several group 2 herbicides. A resistance management plan must be developed before imidazolinone-resistant wheat technology is widely adopted. This work contributes key information for development of an appropriate herbicide management plan. A resulting Pacific Northwest extension publication focuses on the importance of weed biology, most notably seed dormancy and seed longevity in the soil, and how it affects selection pressure for herbicide-resistant weeds and strategies for herbicide rotation. Producers can evaluate the effect of using different efficacy levels and of changing the frequency of herbicide use (annually, biannually, and every third year).

26. INVESTIGATIONS OF WHEAT AND POTATO QUALITY AS A FUNCTION OF STARCH CHARACTERISTICS AND BEHAVIOR

Investigators: Huber, K. C.
Termination Date: 06/30/2005
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Three experiments (designated 1, 2, and 3) contributing to project objectives are reported below. 1) Texture is a key quality determinant of white salted noodles (WSN). Recombinant inbred lines (RILs) of wheat with all combinations of Waxy genes provided a unique opportunity to relate granule bound starch synthase (GBSS) gene dosage with WSN texture. Harder noodles tended to be more adhesive and chewier, whereas a reduction in adhesiveness was correlated with greater springiness, and resilience. Normal starch RILs produced the hardest , most adhesive and chewy, but least cohesive, springy, and resilient noodles. Full waxy RIL noodles were the softest, thickest, least adhesive and chewy, and most cohesive and springy. Partial waxy RIL noodles were intermediate in texture. The GBSS genotype comprised 27-68% of the variance of noodle texture compared to 27-60% variance for the RILs within GBSS class. Based on these results, starch composition is a major contributor to the texture of WSN. 2) Flours of two soft wheat cultivars were fractionated into Native, Prime, Tailing, A-type, and B-type starch fractions to investigate factors related to wheat starch pasting behavior. Starch fractions of each cultivar were characterized with respect to A:B-type granule ratio, amylose content, phospholipid level, and pasting behavior. Though starch fractions displayed only subtle mean differences (<1%) in total amylose, they exhibited a range of mean phosphorus, apparent amylose and lipid-complexed amylose values. A-type (relative to B-type) granules exhibited lower levels of phosphorus, lipid-complexed amylose, and apparent amylose. Starch phosphorus and lipid-complexed amylose contents exhibited negative correlation with fraction pasting attributes, but did not adequately account for starch fraction pasting behavior, which was best explained by the fraction A:B-type granule ratio. This result suggests that granule size itself could contribute to wheat starch pasting behavior. 3) Potato flours of two cultivars representing extremes in potato texture, Russet Burbank (mealy) and IdaRose (waxy), were analyzed with a Rapid Visco Analyzer (RVA) to identify flour pasting characteristics unique to each cultivar. A factorial experiment (included multiple levels of heating rate, peak temperature, and flour concentration) was employed to assess the potential of the RVA to differentiate cultivars. At increasing flour concentrations, RVA viscosity attributes increased in magnitude, but possessed similar pasting curves. A variable heating rate primarily affected events occurring early within the pasting profile (time to gelatinization, time to peak viscosity, peak viscosity), while changes in peak temperature influenced viscosity attributes (trough viscosity, breakdown, final viscosity, total setback) associated with the latter portion of the viscosity curve. A high peak temperature generally resulted in increased breakdown and total setback and decreased trough and final viscosities. Discrimination of cultivar extremes was maximized at moderate heating rates (4 to 6 C/minute), moderate to high levels of peak temperature (85 to 90 C), and intermediate flour concentrations.

Impact:
Due to escalating competition in international commodity markets, issues of end-use quality and functionality are becoming increasingly important factors that influence purchasing decisions of potential buyers. While quality is a relative term that varies according to a particular end-use, it

will be necessary to identify critical factors that dictate "quality" for specific product applications, and to provide legitimate means for defining, gauging, and targeting "quality" and functionality of raw agricultural commodities. At the most basic level, identification of critical factors will facilitate in-depth screening of developing lines by providing plant breeders with information necessary for future selections. The potential to effectively screen for end-use potential represents an additional mechanism for increasing selection efficiency in breeding programs. As traits responsible for functionality (i.e. starch properties) can be manipulated to minimize raw material inconsistency and improve end-use performance, the market value of agricultural commodities will be increased.

27. SHEEP GRAZING FOR NOXIOUS RANGELAND WEED MANAGEMENT IN IDAHO

Investigators: Launchbaugh, K. L.
Termination Date: 06/30/2006
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Research was conducted to determine the potential value of carefully managed grazing to control several noxious weeds common in Idaho and western North America. In 2002, we examined on the value of sheep grazing for spotted knapweed control. We also initiated research on control of yellow starthistle by cattle and sheep. Our research suggests that sheep grazing can effectively reduce flower production and basal area of spotted knapweed growing in a sagebrush grassland community of south eastern Idaho. Sheep consumed spotted knapweed throughout the grazing season and preferred knapweed to native grasses in all seasons. Sheep showed greatest relative preference for spotted knapweed when it was in the bolting stage. Nutritional analysis of knapweed throughout the growing season revealed that the bolting stage corresponded with high nutritive value and low composition of cnicin, a secondary compound thought to reduced palatability. The proportion of spotted knapweed consumed by sheep was not strongly affected by stocking rate. Sheep and cattle both readily consume yellow starthistle in the canyon grasslands of Northern Idaho. Grazing by both livestock species reduced starthistle density when the grazing occurred during the bolting stage. Flower production was not affecting by grazing treatments. In a series of related experiments based on clipping, as simulated grazing, density and flower production were both markedly reduced by defoliation throughout the season

Impact:
It has long been recognized that weed management systems on rangelands must incorporate grazing management plans to be effective. However, we propose a shift in emphasis from working weed control programs around grazing management plans to actively employing livestock in the battle against weeds. Making livestock grazing an active part of a weed control program will require specific prescription grazing guidelines that outline the appropriate number and species of animals and season of grazing. Our research aimed at preparing grazing guidelines and prescriptions will allow land managers to more carefully implement grazing in weed control efforts. This approach is being adopted by producers who are creating livestock enterprises based solely on vegetation management. Livestock employed in weed management can therefore reduce the environmentally damaging effects of noxious weeds and simultaneously create a new type of livestock enterprise and a new product of livestock grazing.

28. VARIABLE RATE NUTRIENT AND IRRIGATION MANAGEMENT FOR SUSTAINABLE CROPPING SYSTEMS IN SOUTHERN IDAHO

Investigators: Stark, J. C.
Termination Date: 06/30/2005
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
The production of high yielding, high protein hard red spring wheat in the Pacific Northwest typically involves applying part of the seasonal N requirement between tillering and flowering. In-season N applications have been effective in increasing grain protein content, but little information is available regarding the effects of late-season N applications on milling and baking quality. A three-year field study was conducted to determine relationships between grain protein content and milling and baking characteristics of irrigated "Iona" hard red spring wheat topdressed at tillering, boot or flowering with either 0, 22, or 44 kg N/ha. The N treatments were applied by broadcasting ammonium nitrate and incorporating it with 2.5 cm of irrigation water applied with a solid-set sprinkler system. Nitrogen timing did not affect milling yield, loaf volume or mixing characteristics and had little effect on relationships between protein content and milling and baking performance. By comparison, topdressed N rate did affect most of the wheat quality characteristics evaluated in the study. Increasing the N rate increased flour protein and loaf volume, but tended to decrease kernel size and flour yield when plant N availability was high. In an additional three-year field study, the responses of four potato varieties to N rate and timing were determined. Nitrogen availability was varied by applying 0, 100, 200, or 300 kg N/ha, with either 1/3 or 2/3 of the total seasonal amount applied prior planting and the remainder topdressed over a 6 week period during tuber bulking. The results showed that the four potato varieties responded differently to seasonal N distribution patterns. For example, Gem Russet and A84118-3 achieved maximum N uptake and tuber biomass earlier than did Bannock Russet and Russet Burbank. Optimal N rates for the four varieties also differed significantly. Nitrogen management guidelines are being adjusted to reflect these differences. An additional study was conducted to determine the effects of controlled release P fertilizers on P availability to potatoes. Monoammonium phosphate (11-52-0) granules coated with polymers designed to control P release increased yields of U.S. No. 1 and over 10 oz tubers of Russet Burbank potatoes compared with standard 11-52-0 fertilizer. Maximum yields were also achieved with lower rates of controlled release P than with 11-52-0.

Impact:
Results of the wheat N management study should alleviate concerns by some in the milling and baking industry that late-season N applications increase grain content without producing proportional increases in milling and baking performance. It appears that as long as optimal but not excessive N rates are used, in-season N applications can be used to increase protein content as well as baking performance. Results of the potato N timing study show that potato N rate and timing need to be adjusted for each variety to achieve maximum yield and quality. University fertilizer recommendations are currently being adjusted to account for the different N requirements. The controlled release P study results show that there is significant potential for reducing P fertilizer rates for potatoes using controlled-release P fertilizer. Apparently, by slowing the release of P from the fertilizer granule, adequate levels of P remain in the soil

solution for longer periods of time thereby increasing potato P uptake and yield in P deficient soils.

29. GENETIC IMPROVEMENT OF BEANS (PHASEOLUS VULGARIS L.) FOR YIELD, PEST RESISTANCE AND FOOD VALUE

Investigators: Singh, S. P.
Termination Date: 09/30/2005
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
The 2002 Cooperative Dry Bean Nursery (CDBN) with 30 entries was evaluated for seed yield, plant type, maturity, and 100-seed weight at Parma Research & Extension Center. Two replicates with each plot of 4-rows 25 ft long were evaluated under normal irrigation, and one replicate under drought stressed condition. Harvested seed still needs to be cleaned, weighed, and data analyzed. The 2002 Western Regional Bean Trial with 16 entries was also evaluated at Parma Research & Extension Center. Experimental design, agronomic management, and data recordings were similar to those of CDBN. In this case also, the harvested seed needs to be cleaned, weighed, and data analyzed. The first multi-state jointly developed anthracnose resistant pinto bean germplasm line USPT-ANT-1 was screened for anthracnose, bean common mosaic virus, common bacterial blight, halo blight, and rust in the greenhouses.

Impact:
Data from CDBN and WRBT should facilitate identification of broadly adapted genotypes. Use of USPT-ANT-1 in hybridization and selection should facilitate development of anthracnose resistant cultivars of pinto and other market classes.

30. ENVIRONMENTAL FATE OF BIOPESTICIDES AND HERBICIDES IN IDAHO POTATO CROPPING SYSTEMS

Investigators: Hutchinson, P. J.
Termination Date: 06/30/2006
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Imazamox at 0, 0.04, or 0.08 lb ai/A (0, 1X, 2X) was applied to Clearfield winter wheat fall 1999, and spring 2000 near Aberdeen, ID. Treatments of fall 1999- and spring 2002-applied 0.04 and 0.08 lb ai/A rates with a simulated winter kill (glyphosate application spring 2000)and plant-back to non-Clearfield wheat Spring 2000 were included in the trial. Potato and sugarbeet planted in the trial area Spring 2002 did not have visual injury symptoms or yield reduction. A second trial was initiated in Clearfield spring wheat Spring 2001. Imazamox at 0, 0.032, 0.04, 0.064, or 0.08 lb ai/A was applied Spring 2001. Barley, potato, and sugarbeet were planted into the trial are Spring 2002. No crop injury was visible during the growing season and yields were not reduced from any treatment. Soil samples collected at application time, and periodically throughout all growing seasons from each trial will be analyzed for imazamox concentration to determine degradation. Sulfentrazone at 1X and 2X the proposed use rate was applied to potato Spring 2002. Brassica green manure was planted into the trial area after potato harvest Fall 2002.

Sugarbeet will be planted Spring 2003.

Impact:
Imazamox and sulfentrazone follow-crop trial results will be used for plant-back restrictions and recommendations. Based on southeast Idaho trial results, these restrictions and recommendations may be different for the Pacific Northwest than what has been determined for these herbicides in other potato production areas. Determination of biofumigant compound degradation, and effects on potato planting timing and crop safety, will assist in developing best management practices for brassica green manures in potato cropping systems.

31. YIELD IMPROVEMENTS OF SPANISH SWEET ONIONS GROWN FROM PRIMED SEED OR FROM METALAXYL TREATMENTS AT PLANTING

Investigators: Geary, B. D.
Termination Date: 06/30/2006
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Effects of test results from the 2000 growing season indicated Ridomil was effective in reducing Pythium damping-off on yellow `Vega' onions when excessive moisture was applied to encourage Pythium populations. Red `Flare', white `Sterling', and yellow `Vega' onions were tested during 2001 under excessive moisture conditions and under normal grower practices. Again, Ridomil was effective in reducing Pythium damping-off by increasing stand counts and increasing yields under excessive moisture conditions for the yellow onions. However, there were no significant differences between the untreated checks in the red and white onions and the treatments under excessive moisture. There were no significant differences between the untreated onions and those treated with Ridomil under normal grower conditions regardless of onion cultivar. One likely possibility for no differences among the treatments was the moderate to low Pythium populations in the soils where the onions were planted. To resolve this problem, in 2002 Pythium was isolated from an onion root and cultured on artificial media. Inoculum was prepared from the cultured Pythium but few reproductive structures grew on the media. Regardless of spore counts in the inoculum, it was injected in a band close to where the seed was to be located. Two days later seed from the yellow `Vaquero' onion variety was planted. Flare and Sterling onions were also planted the same day. All onions were grown under standard grower conditions. In 2002, there were no differences between the untreated check plots and those treated with different formulations of Ridomil. The Pythium inoculum was not effective in raising soil Pythium populations or increasing damp-off in the onions. Ridomil treatments are not recommended for use in the Treasure Valley area of Idaho and Oregon unless the Pythium soil population is high and excessive moisture is expected during the early growing months. Data from primed onion seed experiments in 2000 suggested that priming the seed of varieties `Vision' and `Caballero' was beneficial to onion stands and overall yield. Primed seed for the 2001 growing season could not be obtained, therefore, the second year of the study was conducted during 2002. The variety `Vaquero' was used and was planted in March (normal time for planting onions) and 3 weeks later in April (late planting for onions). There were no significant differences between the primed and unprimed seed in yield or stand counts for both planting periods. However, the primed seed tended to yield better than unprimed seed in plots that were planted in April.

Impact:
Primed onion seed and chemical treatments such as Ridomil, are products that are advertised to boost plant stands and increase yields. Thus, leading to higher economic returns. Even though these products are beneficial to onions under greenhouse or laboratory conditions the results may not transfer to typical field conditions. Therefore, growers request help in determining if these products will benefit them when they are applied in the field under commercial growing conditions. If the tests indicate that the products will help the grower be more productive then the growers are willing to invest their resources to use the products effectively and judiciously. However, if these products do not prove to be beneficial, then growers want to know so resources are not wasted. Products such as primed seed and Ridomil cost $3 to $15 / acre, which increases the cost of production substantially. In the Treasure Valley where 18,000 acres of onions are grown annually, unnecessary products could cost growers thousands of dollars. Therefore, tests determining product efficacy are important.

32. POTATO VARIETY IMPROVEMENT, EVALUATION, MANAGEMENT, AND SEED INCREASES IN IDAHO

Investigators: Love, S. L.
Termination Date: 06/30/2006
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
One new variety, Summit Russet, was approved for release in 2002. This new russet type variety is resistant to most common field diseases and produces a high percentage on U.S. No. 1 tubers with very high fresh market and processing quality. Pre-Nuclear mini-tubers are currently being produced for distribution to seed growers in the spring of 2003. Cooperative research and breeding with Oregon State University and Washington State University was continued and overall efforts increased. The number of seedlings handled by the Tri-State group in the first generation was increased from 210,000 to 240,000. In 2002, 32 trials were grown at seven locations throughout southern Idaho. Included were variety trials, management studies, germplasm enhancement studies, and seed increases. Improvements in germplasm resistant to corky ringspot were evident in 2002. High levels of resistance were found in clones with russet skin, long shape, and good internal quality. Three or four of these clones will be intensively evaluated for yield and quality. A second year of characterization was completed on a population segregating for resistance to corky ringspot that will be used to identify gene markers for resistance. Disease pressure this past year was exceptional and the characterization effective. A study to characterize North American germplasm for vitamin C content was completed and prepared for publication. A three- to four-fold range of vitamin C content was found among commonly used parental germplasm. Several of the clones with high levels of vitamin C were intercrossed to begin a recurrent selection program to test the upper limit. In a quality related study, it was determined that the viscoanalyzer can effectively detect differences in tuber quality as related to baked and fried product texture. Both before and after storage, a strong correlation emerged between viscoanalyzer measurements and consumer preference as determined by a sensory panel. The first year of an irrigation study was completed. One objective of the study was to determine whether variety choice is a viable management factor in dealing with irrigation water shortages. Early indications from the study show distinct differences among varieties for

response to limited water availability.

Impact:
This research is the Idaho component of the Northwest Potato Variety Development Program (Tri-State). This project has had a positive influence on the Northwest potato industry through the release of new varieties that provide advantages of disease resistance, productivity, production efficiency, and tuber quality. Added value of variety releases is now estimated at approximately $135 million. The germplasm base for the breeding project continues to improve and the impact is expected to be greater each year of the life of the project. The ultimate impact of the project will be to maintain the competitiveness of the Northwest industry in an increasingly competitive global market.

33. DEVELOPMENT OF IMPROVED WHEAT CULTIVARS FOR IDAHO

Investigators: Souza, E. J.
Termination Date: 06/30/2006
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
In the past year we released the soft white spring wheat `Alturas' (IDO526). Alturas is a medium-early soft white spring wheat with good yield stability across the Pacific Northwest. In the past two years of yield testing across Idaho it has out-yielded Penawawa and Jubilee. Alturas has been evaluated by Kraft/Nabisco at their Fair Lawn, NJ factory, by US Wheat's Associates in the Asian Products Collaborative, and by the Pacific Northwest Wheat Quality Council. It has excellent cookie quality and can be used in blends with hard white wheat to improve color in most Asian noodles and the texture of Japanese udon noodles. Alturas complements Jubilee as a soft white spring wheat. Alturas tends to be more stress tolerant than Jubilee, while Jubilee performs better than Alturas in intensive management. Alturas is resistant to the Palouse's new races of stripe rust. Moreland (IDO517) hard red winter wheat was released in the past year. It is an irrigated hard red winter wheat with approximately 1 to 1.5 % points higher grain protein than Boundary hard red winter wheat. The bread loaf volumes, volume per unit of protein, and mixing times for Moreland are significantly greater than Boundary and Garland. Grain yields for Moreland are superior to Garland, yet most years are less than Boundary. This year, the later maturity of Boundary seemed to limit its yield potential during the hot weather at the end of grain-filling. Moreland had greater grain yield than Boundary in our yield trials and many of the on-farm trials.

Impact:
Improving wheat quality, decreased production costs, and improved yields will keep Idaho growers competitive in the world marketplace. Moreland will provide irrigated growers with the opportunity to provide local mills with extra-strong high value hard red winter wheat. Alturas will minimize crop loss due to heat related biotic stress.

34. REGULATION OF FUNGAL MORPHOGENESIS AND MULTICELLULAR DEVELOPMENT

Investigators: Miller, B. L.
Termination Date: 06/30/2006
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
We have contiuned a structure/function analysis of two key regulatory genes that control sexual reproduction in the model filamentous fungus Aspergillus nidulans. We have identified important functional domains of these proteins that include DNA-binding motifs, transcriptional activation domains and potential dimerization domains. Both of the proteins of interest, StuA (stunted) and SteA (sterile) have potential cAMP-dependent protein kinase phosphorylation sites that may be critial for regulating their activities in response to environmental signals that induce sexual development. We have also identified and are characterizing a protein kinase (MpkB) and a transcription factor that may regulate SteA expression as part of the signal transduction pathway. We have also performed cellular localization studies on a novel protein that we have identified. The DopA (dopey) protein is found eucaryotic organisms, including fungi, animals and humans. Our results indicate DopA is a novel component of the cellular protein trafficking machinery that responds to intra- and/or extracellular signal to control proper cell polarity (shape) and cell division.

Impact:
Information derived from our studies of asexual and sexual reproduction should provide insight into mechanisms controlling reproduction in filamentous fungal plant pathogens and dimorphic animal pathogens. Novel ways to control these pathogens could be an outcome of these studies.

35. THE EVOLUTION OF PROTEIN FLEXIBILITY

Investigators: Daughdrill, G. W.
Termination Date: 06/30/2006
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Studies to obtain recombinant clones for the 70 kDa subunit of replication protein A from H. sapien, X. laevis, O. sativa, D. melanogaster, S. pombe and S. Cerevisiae are in progress. We have completed subcloning, expression and purification of flexible linkers from four of these homologues for H. sapien, X. laevis, O. sativa, and S. Cerevisiae. Multidimensional, heteronuclear NMR data that will permit the NMR resonance assignments and characterization of the dynamics and secondary structure has been collected for the hsRPA70(105-180) fragment. A comparison of the NMR data collected for hsRPA70(105-180)and a larger hsRPA70 fragment containing residues 1-168 (hsRPA70(1-168)) has revealed the presence of context dependent structure for the flexible linker. HsRPA70(1-168) contains a folded domain from residues 1-104 and the flexible linker from residues 105-168. This result suggests a model of linker function dependent on interactions with the folded domains. Other research includes a revised sequence analysis of newly cloned RPA70 homologues. The most significant outcome from this analysis is the high degree of sequence identity (68%) between the flexible linkers from H. sapien and M. musculus. The sequence identity would be higher if it were not for the presence of a poly-Q

insertion in the M. musculus homologue. The observed level of sequence identity between distantly related mammals suggests the linkers are highly conserved in mammals and the survey should be broadened to include other vertebrates. We also analyzed cloned RPA70 homologues using the predictor of natural disorder regions (PONDR). This program is capable of estimating the presence of flexible regions in proteins that are ten amino acids in length or longer and provides an important foundation for the development of new algorithms that can predict and align flexible sequences. The PONDR prediction showed an excellent correspondence between the predicted regions of flexibility and the experimentally observed regions. When the PONDR prediction is superimposed on the sequence alignment there is a clustering of insertion/deletion events in the flexible regions. When the dynamics and secondary structure for the nine linker homologues has been determined, the data will be used to refine the PONDR algorithm. The PONDR analysis represents a collaborative effort with Keith Dunker and Celeste Brown at Washington State University in Pullman.

Impact:
When novel genes are sequenced their structure and function can often be reliably predicted based on sequence similarity and evolutionary relationships to proteins with known structures. Current methods for describing these relationships assume that the proteins being compared adopt compact rigid structures, ignoring proteins with partially collapsed flexible structures. Flexible proteins and protein domains have important biological functions and analysis of genome sequence data has revealed proteins with flexible regions longer than fifty amino acids are common in nature. If natural selection works to preserve flexible structures then one would expect that the linkers from different species have acquired the same level of flexibility using different sequences. By testing this hypothesis we will begin understand rules governing evolution of protein flexibility. An understanding of these rules will lead to a greater understanding of the role that protein flexibility plays in protein function and has the potential to enhance the predictability of models of evolution. This work will also provide a unique perspective on the dynamic behavior of the molecules of life.

36. PREDICTION OF POTATO LATE BLIGHT AND CONTROL OF POTATO STORAGE DISEASES

Investigators: Miller, J. S.
Termination Date: 06/30/2006
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Weather stations were deployed in potato fields shortly after potato emergence at 10 locations in southern Idaho. Stations recorded temperature, relative humidity, rainfall, and leaf wetness and disease forecast values were calculated each week. Fungicide applications were made 1) weekly, 2) bi-weekly, 3) according to two late blight prediction model (Blitecast and LeafWet), and 4) according to the early blight prediction model (PDay). The Blitecast model never called for fungicide applications. Early blight was the only significant disease. Disease reduction was 29% in plots receiving fungicide weekly, 10% for bi-weekly applications, 23% using the LeafWet model, and 25% using the PDay model. With the PDay model, only 3 fungicide applications were made all year, compared to 7 with the weekly fungicide application regime. Using the PDay model saved 4 fungicide applications without reducing disease control efficacy. Potato

yields in this study were similar for all treatments. Thus, the cost of using the PDay model was significantly lower than using weekly fungicide application. Model performance was also tested in Bonners Ferry where late blight was the prevalent disease. In that location, disease prediction forecasts did not result in a reduction of fungicide use. Four teams of scouts examined commercial potato fields. Early blight and white mold were the primary diseases observed, and the dates of appearance were recorded for both diseases. Colorado potato beetles and aphid presence was also observed. The information was disseminated through a fax service sponsored by Dow and through the University of Idaho Potato Pest Hotline. Information on fungicide use, cost, application method, and application timing is currently being collected. Plots were established in Aberdeen (2002) and Minidoka (2001, 2002) to evaluate the effect of Ridomil application method on pink rot incidence. Treatments included in-furrow at planting (IFAP), hilling, IFAP + foliar, and two foliar applications. At Minidoka, application by chemigation was also tested. Disease incidence in the field was low. Tubers were inoculated in the lab with Phytophthora erythroseptica. Disease incidence was significantly reduced by all application methods, with hilling being the most effective (84% reduction), followed by foliar application (65% reduction), IFAP (48% reduction), and chemigation (40% reduction). A survey of P. erythroseptica sensitivity to mefenoxam was conducted. A total of 85 single tuber isolates were assayed from south-central and eastern Idaho. EC50 values were calculated for each isolate and 36% of the isolates had values between 0-10, 4% between 11-80, 28% between 81-150, and 32% over 150. Aggressiveness of mefanoxam-resistant and mefenoxam-sensitive isolates has not been thoroughly tested yet. A preliminary study showed no significant difference between resistant and sensitive isolates for zoospore germination rates (53% and 46%, respectively). These tests will begin in the spring of 2003. Oospore longevity tests have not been conducted at this time. These tests will begin in the Spring of 2003.

Impact:
Growers will be able to use disease forecasts to reduce unnecessary fungicide applications early in the growing season. Results from 2002 indicated growers could have saved four fungicide applications, translating into a reduction in 8 pounds of fungicide applied per acre and a minimal savings of $40 per acre. Growers will begin using these forecasts in 2003, leading to economic savings and decreased fungicides applied to the crop. Pest scouts informed potato growers of the onset of disease, allowing growers to improve the timing of disease control measures. This helped some growers delay fungicide and insecticide applications, reducing pesticide use. Surveys of fungicide resistance for the fungus causing pink rot showed that fungicide applications would not be useful. The fungicide sensitivity information led to some growers choosing not to manage pink rot by fungicides, relying on cultural practices such as water management or the planting of alternate crops. These practices were not always successful, but did work in some cases.

37. PLANT AND SOIL TEST CALIBRATION FOR IRRIGATED CROPS IN SOUTHERN IDAHO

Investigators: Brown, B. D.
Termination Date: 06/30/2007
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Stems were collected twice in summer during growth of several peppermint and spearmint varieties or advanced lines to evaluate variety differences in stem nitrates. Spearmint varieties differed more in stem nitrates than peppermint varieties. Results indicated stem nitrates may differ sufficiently between peppermint and spearmint and among varieties of the same species to influence the interpretation with respect to the need for supplemental in-season N applications. A study was initiated to measure and document the N mineralized after small grains following previous row crops and alfalfa seed. Soil samples from the 0-30cm depth were collected from small grain fields prior to re-wetting. The soils were uniformly processed, bagged and buried in soil to a depth of 30cm. Initial inorganic N was measured in the soils but the inorganic N change with time in the buried bags won't be measured until the bags are removed in December.

38. PLANT VIRUS INFECTION-INDUCED VOLATILES AND VECTOR BEHAVIOR
Investigators: Eigenbrode, S. D.
Termination Date: 06/30/2007
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
This new Hatch project is designed to study the effects of virus infections of crop plants on plant characteristics that influence aphid vectors of these diseases. The emphasis is on volatile production by the plants. In the potato/potato leafroll virus/green peach aphid pathosystem, we have shown that infection of potato plants by potato leafroll virus (PLRV) induces volatile organic compounds (VOC) that include attractants for its principal vector, green peach aphid (GPA). Electrophyisologically (electroantennogram response) the aphid is most sensitive to (E)-2-hexenol, among those VOC whose production is increased by PLRV infection. This compound is also the most arrestant of any compound tested so far with this aphid. However, this response does not explain the full response by aphids to the VOC emitted by infected plants. More work is required. In the wheat/barley yellow dwarf virus/bird cherry-oat aphid pathosystem, we have discovered a similar response by the vector to infected plants. This is also apparently influenced by VOC. Wheat infected by barley yellow dwarf virus (BYDV) is attractive to the bird cherry-oat aphid (BCOA), even when the insects are not permitted to touch the plant surfaces and when tested in the dark. Wheat infected with BYDV produces more VOC, notably (E)-2-hexenol-acetate, a known attractant for BCOA. Thus, in the two systems studied so far, both involving viruses in the Luteoviridae, a similar phenomenon occurs in which 6-carbon VOC induced by viral infection are attractive to the principal vectors of these viruses.

Impact:
Long-term implications of this research are applications to manipulate the behavior of aphid vectors of important viral diseases of crops. BYDV and PLRV are among the most serious viral diseases of wheat and potato, respectively. Tools to improve the management of vectors of these viruses are sorely needed.

39. MODELING OF STRESS-CRACKING IN FOODS AND BIOMATERIALS USING HYBRID MIXTURE THEORY AND EXPERIMENTAL VERIFICATION

Investigators: Singh, P. P.
Termination Date: 06/30/2007
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
To date, research has been initiated on mathematical modeling establishing experimental procedures on viscoelastic properties of food materials, and the second graduate student is establishing the experimental procedure on visualization of stress-cracks in foods using nuclear magnetic resonance (NMR). A food rheology lab has been established at University of Idaho, with capabilities of determining viscoelastic and other rheological properties of food materials. Collaborations have been developed with researchers at Washington State University for performing NMR experiments, and with researchers at University of Arizona to determine the hydration stresses in foods.

Impact:
The research is expected to improve the quality of food materials by preventing damage caused by stress-cracking.

40. BENZENEDIOLS AND BENZOQUINONES: ROLES IN WOOD DECAY BY BROWN-ROT FUNGI

Investigators: Crawford, R. L.
Performing Department: Microbiology, Molecular Biology and Biochemistry -- 5176
Start Date: 09/15/1999 Termination Date: 09/30/2002
Reporting period: 09/15/1999 to 09/30/2002

Termination Report:
Our research results indicate that the brown-rot fungus, Gloeophyllum trabeum, secretes not only oxalic acid but also 4,5-dimethoxycatechol and 2,5-dimethoxyhydroquinone into its growth medium. We found that eight species belonging to the genus Gloeophyllum produce oxalic acid, and five of them produce methoxyhydroquinones. These small organic molecules, together with transition metal ions and hydrogen peroxide, play roles in bio-Fenton catalyzed extracellular reactions, which are believed to be major mechanisms of initial wood attack by brown-rot fungi. Oxalic acid production and its role in the stabilization of metal ions is a very well known phenomenon in fungal systems. It has been shown by others that during in vitro reactions this system can produce hydrogen peroxide and depolymerize polyethylene glycol. We also observed that the fungal Fenton-based system will promote the degradation of xenobiotic compounds such as the munitions component trinitrotoluene (TNT). These preliminary findings raise very important biochemical questions. How does this system work in concert with other metabolic processes to produce rapid brown-rot decay of wood or degradation of anthropogenic xenobiotic chemicals? How do brown-rot fungi protect themselves from these very reactive mixtures? We have been pursuing answers to these questions.

Impact:
The research performed under this award has provided specific information about mechnaisms of

brown-rot wood decay that should allow progress toward developing environmentally friendly means to prevent wood decay in man-made wooden structures.

Allocated Resources IAES Program 1:

RPA	SY	PY/TY	Amount
102	1.72	0	$944,536
123	0	0	$40,506
201	1.8	5.76	$1,530,556
202	.57	1	$101,342
203	2.06	1	$604,408
204	3.35	.55	$898,169
205	1.08	1.3	$345,454
206	.67	0	$215,417
211	4.97	6.86	$1,320,105
212	4.45	1.39	$970,298
213	2.6	1.78	$710,286
214	1	0	$111,505
501	.75	0	$143,148
502	.75	2	$266,029
Total	25.77	21.64	$8,201,759

IAES Program 2: Animal Health and Well-Being (RPAs 301, 302, 305, 307, 311, 312 and 313). Also under **REE GOAL 1**, IAES Program 2 is the third largest program area encompassing 15 research projects and approximately 13 faculty SY.

Performance goals:
Improved animal management and the detection, control and treatment of infectious diseases of domestic animals in the Northwest and United States. Animal well-being and performance and livestock and dairy product quality and consistency will be monitored and maintained for the benefit of producers and consumers.

Progress/Impacts:

1. RELAXATION OF ISTHMIC CIRCULAR SMOOTH MUSCLE: PROPOSED MECHANISM BY WHICH PGE2 OF EMBRYO ORIGIN
Investigators: Woods, G. L.
Termination Date: 06/30/2002
Reporting period: 07/01/1996 to 06/30/2002

Termination Report:
The objective of this experiment was to clone a mule. Twenty one of three hundred and nine(6.8%) cloned mule embryos resulted in pregnancies detected with transrectal ultrasonography. Three of twenty one pregnancies (14.3%) have advanced beyond 100 days of gestation.

Impact:
Horses relative to humans have a hypothesized low cell activity. This hypothesis of low cell activity in horses is based upon the low in vitro fertilization rates and low cancer mortality in horses relative to humans. Understanding and manipulating the chemicals responsible for the hypothesized low cell activity in horses may be key to successfully cloning equine species. In parallel, understanding and manipulating key chmicals may provide opportunities to prevent and or treat age-onset diseases in humans.

2. THE REGULATION OF BACTERIAL AUTOLYSIS

Investigators: Bayles, K. W.
Termination Date: 06/30/2003
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
A major advance in our research was the identification of an additional operon in Staphylococcus aureus (designated cidABC) that we believe encodes a holin component of our autolysis regulatory system. The products of the cidA and cidB genes share 23% and 32% sequence identity with the previously characterized lrgA and lrgB gene products, respectively, and the cidA gene product (like the lrgA gene product) exhibits physical characteristics in common with holins. Studies of a cid mutant (strain KB350) indicate that this operon functions in a manner that is diametrically opposed to the lrgAB operon. The KB350 strain exhibited decreased extracellular murein hydrolase activity and sensitivity to penicillin-induced killing, just opposite to that observed with the lrg mutant. The effects of the cid mutation were not a function of growth rate differences as this strain (as well as the lrg mutant) has the same doubling time as the parental strain under all growth conditions tested. Interestingly, complementation experiments revealed that only the effects of the cid mutation on murein hydrolase activity could be complemented by supplying the cidAB gene product in trans. Why the decreased sensitivity to penicillin could not be complemented is not known although it may involve the recent finding that a third gene, cidC (encoding a pyruvate oxidase homolog), is also encoded in this operon. The cidB and cidC probes both hybridized to a 2.6 Kb transcript, while the cidC probe also hybridized to a smaller, 2.2 Kb transcript. If the cidC gene product is responsible for the penicillin sensitivity phenotype, complementation with the cidAB genes would not restore the wild-type phenotype. This possibility is currently under investigation in our laboratory. Recent studies have demonstrated a marked strain dependence of cidBC transcription. This was originally observed in a clinical S. aureus isolate where the 2.6 Kb cidBC transcript appeared to be dramatically overexpressed relative to our laboratory strain, RN6390. Given that RN6390 has a known defect in its ability to activate the recently characterized alternative sigma factor, Sigma B (involved in the stress response), we reasoned that Sigma B might be required for optimal cidBC expression. This appears to be the case. The expression of the cidBC transcripts was dramatically enhanced in the SH1000 (a Sigma B active strain) at all time points analyzed

compared to the isogenic 8325-4 strain that produces inactive Sigma B. These data indicate that cidBC expression is part of the Sigma B regulon, suggesting that it might be part of the cellular response to stress.

Impact:
The primary impact of our research involves the discovery of what we believe is an entirely new aspect of bacterial physiology, that involving programmed cell death. The implications of this are significant since it should shed light on the mechanism of antibiotic-induced killing, which has been enigmatic since the discovery of penicillin. Because of its role in bacterial cell death, this system holds considerable promise in the development of novel antimicrobial compounds that are desperately needed in the fight against bacterial infections.

3. VIRULENCE GENE MODULATION IN YERSINIA ENTEROCOLOTICA
Investigators: Minnich, S. A.
Termination Date: 06/30/2003
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Our basic goal is to understand temperature regulation in pathogenic bacteria. Our model is Yersinia enterocolitica. Pathogenic Yersinia phase vary among various henotypes between 30 and 37 degrees Celcius. Part of this switch includes type III protein secretion systems. We have determined that this is necessary because secreted proteins from different type III systems can be cross-recognized. We have now extended our studies and shown that a virulence protein, YopM, is recognized and secreted from the flagellar structure, but only in a deletion mutant which has all three flagellin genes removed. We have also extended and found cross-recognition extends to a third typeIII system (Ysa)regulated by high salt. Thus, the three type III systems are segregated by environmental cues to prevent cross-contamination. During the past year, we focused on characterization of this new typeIII system. In addition, we initiated studies on DNA methylation involvement in virulence regulation. Finally, we have been conducting microarray analysis of tempurature regulation studies in collaboration with investigators at the University of Illinois.

Impact:
These results have a broad impact both on animal and plant pathogenesis. Type III systems are common to most Gram Negative bacteria. We have definitively shown that segregation of multiple type III systems is necessary, and most likely explains why flagellar biosynthesis must be regulated in the host.

4. STUDY OF TRANSMISSION AND EARLY DETECTION OF SCRAPIE
Investigators: Bulgin, M. S.
Termination Date: 06/30/2003
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
We have identified 47 cases of natural scrapie so far in our group of highly exposed ewes. We have tallied the percentage of the various lymphoid tissues in these animals that test positive

(using an Immunohistochemistry Test (IHC)) as compared to the brain. The results are as follows: eyelid 57 precent, tonsil 70 percent, mandibular lymph node 64 precent, retropharengeal lymph node 79 percent, intestinal peyer's patches 66 percent, and brain 79 percent. This suggests that the mandibular lymph node is another option as a live animal test as it is relatively easy to biopsy this node. The small number of negative brain samples represent those animals that died of another disease before they succumbed to scrapie, thus, peripheral tissues are positive, but the brain, which is the last to become infected, is not. We have also collected urine from clinical and eyelid-positive subclinical ewes and some control ewes providing a blind panel for collaborating with researchers that are trying to identify the abnormal prion in urine. We have also collected over 80 liters of blood from clinically positive ewes over a 2 1/2 year period for processing by our collaborator, Dr. Rohwer, to provide positive control material for other researchers in the field. This year we have had 10 positive animals die. We are in the process of genotyping the sheep for the 136 and 154 codons, two more sites on the chromosome that are felt to be important in scrapie resistance. All of our sheep have been tested and are of the susceptible American common genotype QQ. In spite of this, we have a group of aged ewes that are still very healthy. This may be explained by their genetics relative to the other two codons.

Impact:
This flock, naturally infected with a wild strain of scrapie, is the only resource of its kind. Researchers utilize it, as a reliable source of abnormal prion in its natural host, in their their studies of either scrapie or Creutzfeldt-Jakob disease of humans. Further, it is providing a valuable tool to study the epidemiology of the natural disease in sheep.

5. PHYSIOLOGY OF INSECT BEHAVIOR

Investigators: Klowden, M. J.
Termination Date: 06/30/2003
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Because our prior experiments demonstrated that male accessory glands were not involved in the switch to mated behavior by female Anopheles gambiae mosquitoes, we examined both the roles of the female spermathecae and of her cuticular hydrocarbons that we also demonstrated undergo a change following mating. Removal of the spermatheca from either a mated or unmated female abolished oviposition behavior, as did gently smashing the spermathecal capsule with forceps from the outside. These data support our hypothesis that the spermatheca is responsible for the switch to mated behavior in anophelines. We also observed a significant sperm polymorphism in only the gambiae males, with the longer sperm most likely to be retained in the female spermatheca. This too may be related to the regulation of female behavior by the spermatheca.

Impact:
One strategy for reducing insect-borne disease is to genetically engineer the mosquitoes so they are no longer capable of harboring the parasites. In order for this approach to work, more information is required about mosquito mating systems, because the new genes will have to be distributed to field populations of female mosquitoes by engineered males. This research will determine the mechanisms of mosquito mating and the factors that may lead to multiple mating.

6. REGULATION OF THE DIGESTION KINETICS OF PROCESSED CEREAL GRAINS

Investigators: Hinman, D. D., Sorensen, S. J.
Termination Date: 06/30/2004
Reporting period: 07/01/1999 to 06/30/2004

Termination Report:
Dr. Hinman retired from the University of Idaho. The results of this study indicate that dry roasting then rolling barley reduces the rate of animal digestion more than tempering roasting rolling barley (which actually enhanced early starch disappearance rate) to a rate similar to dry rolled corn. Dry roasting and rolling barley grain without tempering reduces the amount of energy and equipment costs associated with grain processing.

Impact:
Animal feed producers are using the findings of this project to more efficiently use barley as a feed for ruminant livestock.

7. STRATEGIES FOR OPTIMIZING THE UTILIZATION OF ENERGY RESOURCES BY DOMESTIC RUMINANT ANIMALS

Investigators: Hunt, C. W.
Termination Date: 06/30/2004
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Two digestion trials and an in situ trial were conducted to evaluate methods of enhancing the utilization of grass seed aftermath. The digestion evaluated a fibrolytic enzyme extract as an exogenous enzyme additive for bluegrass straw-based diets. The enzyme was either add to the straw (trial 1) or to the concentrate (trial 2) portion of the diet. We observed the exogenous enzyme to have no benefit in enhancing the utilization (intake or digestibility) of the bluegrass diets. We conclude that the exogenous enzymes would not be beneficial when provided in a healthy, active ruminal environment. The in situ trial had a factorial treatment arrangement and was conducted to identify optimal bale density (low and high), moisture content (dry = 5%, 14%, and 17%), and level of ammoniation (3 and 5%) on in situ dm disappearance (ISDMD) of bluegrass straw. Bluegrass straw was harvested in 2.4 m x 0.9 m x 0.8 m bales and had densities of 152 and 122 kg/m3 for high and low density bales, respectively. Four bales per treatment were ammoniated in stacks for 2 months and core samples were obtained from external and internal bale locations. Five-percent ammoniation yielded greater ($P < 0.10$) CP values than 3% ammoniation at all density by moisture combinations except for dry, low-density bales. Thirty-six-h ISDMD of untreated bluegrass was lower ($P < 0.10$) than all ammoniation treatments except low moisture, high-density bales treated with 3% ammonia ($P = 0.16$). Low moisture bales had lower ($P < 0.05$) ISDMD than medium and high moisture bales at 36 h (46.4% versus 50.3 and 49.3%) and 96 h (69.6 versus 74.9 and 75.4%) of incubation. A level of ammoniation main effect was also observed for 36-h ISDMD with 5% ammoniated straw having greater ($P < 0.05$) degradability than 3% ammoniated straw. However, a trend ($P = 0.11$) for a moisture x density x ammoniation level interaction was observed for 36-h ISDMD. The nature of this interaction suggests the response to 5% ammoniation is not greater than 3% ammoniation when

bales contain 14% or greater moisture or when the bales are of a high density. Moisture content and bale density affected ammoniation response. Two-hundred forty Angus x Salers steers (initial wt 381 +/- 30 kg) were used in a 2 x 3 factorial arrangement of treatments to determine the effect of grain type (corn and barley) and level of DIP on performance of finishing cattle. Dietary treatments included corn- or barley-based finishing diets balanced with 11.5, 12.75 or 14 percent CP using soybean meal and urea. Corn-fed cattle had greater ($P < 0.05$) DM intake, ADG, final weights and feed efficiency than cattle fed barley-based finishing. As dietary DIP levels increased, total gain and ADG increased linearly ($P < 0.05$). Growth performance variables of the grain type main effect were not interactive with DIP level, indicating type of grain did not affect DIP requirement under the conditions of this experiment.

Impact:
The studies involving ruminant animal utilization of grass seed straw has a substantial potential impact. Grass seed growers currently burn crop aftermath to inspire greater perennial seed production. While this practice has seed production benefits, environmental standards are changing which will soon prohibit such open-field burning. Methods to identify feasible alternative uses of grass seed aftermath are critical to the continued viability of grass seed production. While grass seed straw typically have less than the required levels of energy and protein for wintering beef cattle, our studies have identified methods of ammoniation that can enhance the nutritive value of grass seed straw to a point of feasibility. Barley is an important feed grain in the western US, however differences in fermentability of starch in barley compared with corn indicate the need for alterations in finishing diet formulation. Theoretically, greater starch fermentability would suggest the need for a greater level of dietary degradable protein to accommodate greater populations of ruminal microorganisms. Our observations, however did not support this theory. We feel it is important that the quality of barley evaluate in our current year study was less than normal for barley in our region. Consequently, an important impact of our study was to identify the importance variable barley quality on beef cattle performance.

8. Gastrointestinal Diseases of Newborn Calves: Search For Additional Causal Phenomena
Investigators: Anderson, B. C.
Termination Date: 06/30/2005
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Whereas this project has focused primarily on gastroenteric pathogens of the newborn calf, it was discovered that the nonfatal gastric pathogen Cryptosporidium andersoni in young calves and collected data on oocyst shedding by these young to adolescent cattle. This Cryptosporidium parasitizes the gastric glands of the abomasum of cattle and, in dairy milking cows with permanent infestations, has reduced the flow of milk by about 12% on average. Review of data collected from the pens of immature dairy calves has shown the oocyst shedding from calves as young as 2 weeks old. Further, serial collections of fecal samples from replacement heifer pens on a dairy with relatively high prevalence among adults (8-12%), showed the prevalence of oocyst shedding from recently weaned heifers to be 10-15%. Prevalence of C. andersoni oocysts shedding among yearlings on the same dairy was consistently 20-30% with a lesser rate among 18 month old heifers of about 10-15%. It seems likely therefore, that Cryptosporidium andersoni is a readily available protozoan parasite on this dairy. It is likely that all calves are exposed; that

most, if not all, calves suffer a productive infection, and that up to 90% of them become immune, at least to the point of no detectable shedding of the oocyst in feces. Nevertheless, as was demonstrated previously, about 10% of this population of dairy cattle remains in the infected or carrier state, with detrimental effects on milk production. Data suggest that C. andersoni infected feedlot calves have reduced weight gains and reduced about a third in certain individuals during the period of oocyst shedding. This is not surprising given that parasitized animals, no matter the parasite, eat less. The C. andersoni parasitized abomasum has hyperplastic parietal glands with metaplasia that results in reduced acid flow. The abomasal pH instead of being the normal 2, is elevated to about 5. Such a situation reduces the pepsinogen to pepsin conversion as demonstrated by elevated pepsinogen in plasma. With the imminent collection of additional data from large dairy replacement heifer farms and holstein beef feedlots, the overall prevalence of this parasitism among these young dairy animals will be estimated and significant studies on performance or weight gains will be continued.

Impact:
This work has identified and documented a new parasite of the bovine that may have significant impact on the dairy industry. This project sets the stage for future research on prevention and control of C. andersoni parasitism.

9. IMPROVING THE EFFICIENCY OF FEED PROTEIN UTILIZATION IN THE DAIRY COW

Investigators: Hristov, A. N.
Termination Date: 06/30/2005
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Two major experiments related to this project were conducted in 2002. The objective of the first study was to investigate the effect of grain type and a yucca-based product, Grain PrepO, on ruminal fermentation and specifically, ammonia utilization by mixed microbial populations, in vitro. Three, 8-h incubations were carried out with ruminal inoculum obtained from two lactating dairy cows. Grain PrepO-treated (0, 60, and 120 ppm) feed mixtures were incubated at 1.5% concentration with buffer and ruminal inoculum. The grain part of the feed mixture was either ground corn (Corn) or 50% corn and 50% high-amylopectin (waxy) barley grain (Barley). Across incubation time-points, inclusion of 50% barley into the grain mix slightly increased ($P < 0.05$) media pH and decreased ($P < 0.05$) ammonia concentration. Concentration of total and individual VFA was not affected ($P > 0.05$) by type of grain. Grain PrepO linearly increased ($P < 0.05$) ruminal pH but had no effect ($P > 0.05$) on ammonia or VFA concentration. Incorporation of 15N (used to label the ammonia N pool at time 0 h) into fluid bacteria tended to be greater ($P = 0.107$) in Barley than in Corn. Overall recovery of the ammonia tracer in high-speed pellets was not affected ($P > 0.05$) by type of grain. The overall proportion of bacterial N originating from ammonia N was also not different ($P > 0.05$) between Corn and Barley (16.5 and 17.6%, respectively). Grain PrepO had no effect ($P > 0.05$) on the tracer-related parameters but tended to increase ($P = 0.111$) the proportion of bacterial N originating from ammonia N at the end-point of the incubation. The objective of the second trial was to investigate the effect of a medium-chain saturated fatty acid, lauric acid, on ruminal fermentation, nutrient flow and digestibility, utilization of ruminal ammonia N for milk protein synthesis, and milk yield and composition.

The design of the trial was a cross-over involving four ruminally and duodenally cannulated lactating dairy cows. Cows were fed (DM basis) a 46% concentrate (barley, corn, cottonseed, soybean meal):52% forage (alfalfa hay, triticale silage) diet, twice a day. The daily dose of LA (0, Control or 240 g/cow, LA) was divided into two equal portions and introduced directly into the rumen through the cannula before the two feedings. LA had no effect ($P > 0.05$) on ruminal pH (6.0 and 6.1), ammonia (12.0 and 11.8 mM), and VFA concentration (128.0 and 121.4 mM) and composition (Control and LA, respectively). Compared to Control, protozoal counts were reduced ($P < 0.05$) by LA (11.14 vs 0.98 x 105/ml, respectively). Carboxymethylcellulase and xylanase activities of ruminal fluid were lowered (by 40 and 36%, respectively; $P < 0.05$) and amylase activity was not affected ($P > 0.05$) by LA compared to Control. DM intake and DM, OM, CP, NDF, and ADF digestibility were not different ($P > 0.05$) between the two treatments. Milk yield (28.8 and 29.6 kg/d), FCM yield, milk fat (3.43 and 3.38%) and protein (2.92 and 2.79%) concentrations and yields and milk urea N content (24.6 and 21.1 mg/dl; Control and LA, respectively) were not affected ($P > 0.05$) by treatment.

Impact:
The overall goal of this project is to improve the efficiency of feed nitrogen utilization in dairy cows. The results from the above-described experiment suggest that peptide nitrogen may be incorporated at a faster rate by the ruminal microorganisms. This finding confirms previous in vitro reports and can be used to better formulate diets for dairy cows.

10. IMMUNOSUPPRESSION BY SUPERANTIGENS: ROLE IN BOVINE MASTITIS
Investigators: Bohach, G. A.
Termination Date: 07/01/2005
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
We propose that immunomodulation by staphylococci predisposes the bovine to mastitis and hypothesize that superantigens (SAgs), such as staphylococcal enterotoxins (SEs) suppress bovine immunity. This project contains four objectives: 1)To determine the mechanisms by which type C SE (SEC) induces a reversal of the CD4:CD8 T lymphocyte ratio. 2)To characterize purified subpopulations of mononuclear cells in the context of Type 1 and Type 2 immune responses. 3)To characterize the bovine CD8+ACT3+ T lymphocytes induced by SEC. 4) To identify and characterize novel bovine-associated staphylococcal SAgs. During the past year, we have continued assessing the significance of the ACT3 molecule which we have identified as the bovine form of CD26. We cloned and sequenced the bovine CD26 gene and confirmed that the protein was ACT3. In addition, we have characterized the cytokine profile of mixed cell populations as well as of several putative immunosuppressive cell subpopulations obtained by sorting. These combined in vitro results are consistent with a multi-factorial immunosuppression that could promote the survival of intracellular staphylococci. In addition, we have been expanding these studies to in vivo systems and developing all of the assays needed for analyzing the effects of SEC in vivo. These include real time PCR specific for bovine cytokines and RT-PCR to detect activation markers characteristic of immunosuppressive T cells. In addition, we have been working with surgical staff and the nearby Dairy Center in Washington State to develop surgical techniques for implanting toxin-filled osmotic pumps which will allow delivery of regulated amounts of toxin to bovine mammary tissues. Thus far,

we have completed two experiments and have shown that the abnormal lymphocyte phenotypes induced by SEC in vitro also are induced locally and systemically in vivo. This is a significant finding that validates several years of in vitro analyses. We expect to expand these in vivo studies in the upcoming year. For the forth objective, we have begun a collaboration with a group form Ireland in performing extensive strain analysis for the presence of SE genes in bovine isolates. By the time this is finished, we will have analyzed nearly 500 isolates from North America and Europe.

Impact:
A confirmed role for staphylococcal super antigens in pathogenesis of bovine infectious diseases, particularly those associated with persistent colonization and intracellular survival, would be consistent with the inability of traditional approaches to control this significant disease problem for the animal agriculture industry. These results may help lead to more effective means to control mastitis by allowing a more thorough understanding of the pathogenesis involved. The identification of this immunomodulatory activation marker, plus other prior findings regarding the mixed cytokine response induced by enterotoxin C complements our demonstration of staphylococcal ability to enter and survive in bovine mammary epithelial cells. This property would be expected to promote immune evasion and a lack of effectiveness for conventional vaccines.

11. ANALYSIS OF INTRAFLAGELLAR TRANSPORT AND ITS ROLE IN CILIARY ASSEMBLY IN PLANTS, ANIMALS, AND PROTOZOANS

Investigators: Cole, D. G.
Termination Date: 06/30/2005
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
In the past year, we have continued to advance toward completion of our goals in the study of specific components of the intraflagellar transport (IFT) machinery. We have now completed cloning the Chlamydomonas IFT81 (p81) gene. We have now completed the cloning of all of the IFT proteins that were described in our original proposal and have completed cloning of a few new genes. These include IFT57, IFT81, IFT88, IFT139, IFT172, FLA10H (FLA10 homologue), KAP (kinesin-II-associated polypeptide) and a new, IFT-associated protein we have termed IFTA. Because we now have the sequences of all these proteins, we have begun characterizing how these proteins come together to form large transport complexes. To do this, we have developed a new technique where we use chemical cross-linkers to permanently cross- link two proteins together. Following several separation techniques, we then subject the two cross-linked proteins to MALDI-TOF mass spectrometry to identify which two IFT proteins are present. To complement our chemical cross-linking studies, we are also using a yeast two-hybrid analysis which allows us to carefully dissect which domain of protein A interacts with a specific domain of protein B. By combining these techniques we have managed to gain significant information regarding the architecture of the IFT transport complexes. We also plan to use these same techniques to identify novel proteins that interact with the IFT complexes. Indeed, chemical cross-linking has already allowed us to identify IFTA, a novel IFT-associated protein that is strongly conserved from green algae to human (49% identity over a 700 amino acid length). In

summary, we will continue to better understand intraflagellar transport by characterization of the transport machinery architecture/structure and through the identification of proteins with whom they associate.

Impact:
Intraflagellar transport (IFT) within cilia and flagella is necessary for the assembly and function of the organelle. Found in diverse organisms, cilia and flagella can generate movement and are often used as sensory organelles. It is partly because of this that we have been able to link intraflagellar transport with several human diseases. The most prominent of these are polycystic kidney disease (PCKD) and retinal degeneration, both of which we have published on in the past two years. Of particular interest is the fact that our work on the PCKD has led to the discovery that the polycystin-1 and polycystin-2 proteins are found in the primary cilia of the collecting duct of the kidney. It is logical to anticipate that, in the near future, additional human and animal disease states will be linked to the intraflagellar transport machinery. The IFT57 protein, for example, has recently been shown to interact with the Huntington-interacting protein, suggesting a link to Huntington's disease. We will continue to explore these possibilities as we continue our characterization of this intracellular transport process.

12. INCORPORATING ESTRADIOL CYPIONATE INTO THE TIMED ARTIFICIAL INSEMINATION BREEDING PROTOCOL TO IMPROVE PREGNANCY RATES IN CATTLE

Investigators: Ahmadzadeh, A.
Termination Date: 06/30/2005
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
There is evidence that the induction of ovulation by gonadotropin releasing hormone (GnRH) during proestrus, as occurs in the OvSynch (OVS; GnRH-- 7 days --> prostaglandin --2 days --> GnRH -- > Timed artificial insemination) breeding protocol may impair ovarian estradiol secretion and shorten the subsequent luteal phase in cattle. It was hypothesized that administration of estradiol cypionate (ECP) at the time of the second GnRH injection would effectively synchronize ovulation and improve conception rate. The objective was to determine the effect of low dose ECP incorporation into OVS on expression of estrus and conception rate in beef cattle. One hundred eighty two British cross-bred cows (55-60 d postpartum) received intramuscular (i.m.) injection of 25 mg prostaglandin F (PGF) (d -14). Fourteen days later 100 ug GnRH was administered (i.m.;d 0) followed by 25 mg PGF on d 7. On d 9 cows were assigned randomly to receive either GnRH + 0.25 mg ECP (OVS-ECP; n=90) or GnRH + vehicle (OVS; n=92). All cows were artificially inseminated (AI) 12-15 h post treatment by a single AI technician. Estrus activity was monitored 3 times daily after PGF administration and pregnancy determined by ultrasonography 40 and 60 d post-insemination. More cows ($P < 0.05$) were detected in estrus in the OVS-ECP group (45%) compared to the OVS group (25%). Conception rate from AI was 68% and 57.5% for OVS-ECP and OVS, respectively ($P < 0.15$) and was not different between d 40 and d 60 post-insemination. These results suggest that incorporation of a low dose of ECP into conventional OVS increases estrous behavior and may improve conception rate.

Impact:
A calf conceived in the first week of a breeding season would bring an additional $30/head compared to calf conceived 3-4 weeks later. In a five hundred head cow/calf operation and within two breeding cycle, a 10% increase in pregnancy rate in the first day of a breeding season may bring additional income of $2,000-$2,500. The proposed modified breeding protocol helps to keep cows conceiving early breeding season, provides more uniform calf crop, and helps to improve reproductive performance of herds during the following breeding season. Thus, the present breeding protocol has potential to have a major impact on managing reproduction of cows and enhancing profitability of cow calf operations.

13. REPRODUCTIVE PERFORMANCE IN DOMESTIC RUMINANTS

Investigators: Ott, T. L.
Termination Date: 09/30/2006
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
The majority of early embryonic loss occurs during the periimplantation period. To reduce the incidence of early embryonic mortality we must have a better understanding of the biochemical communication between the early embryo and the uterus. This project investigated regulation of uterine gene expression using recently developed immortalized cell lines derived from the ovine uterus. The ovarian steroid hormones estrogen and progesterone drive reproductive cycles. However, the interaction between these steroids and embryonic signals during the periimplantion period is poorly described. Using cell lines as in vitro models for the ovine uterus, we have been able to address these questions while reducing the number of animals used in our research. Results indicate that cells derived from the lumenal and glandular epithelium respond differently to steroid hormones and interferon tau compared to those derived from the stroma. Interesting, the non-ovarian steroid, cortisol, also affects the ability of interferon tau to regulate Mx gene expression. Blocking cortisol action with RU486 resulted in a reduction in Mx gene expression in cells derived from the lumenal epithelium suggesting that stress may compromise reproduction by interfering with the uterine response to embryonic signaling. Southern blot analysis is being utilized to confirm 46 clones containing the ovine Mx gene. Positive clones are being sequenced to determine the sequence of the ovine Mx promoter/enhancer region. To understand the complex regulation of conceptus-uterine interactions, we examine expression of two interferon stimulated genes, ISG17 and Mx, in the uterine endometrium during the cycle and early pregnancy and determined that Mx is regulated differently than ISG17 and perhaps other ISGs. These results suggest unique signaling pathways for Mx and perhaps more complexity in interferon signaling than previously postulated.

Impact:
Early embryonic mortality costs animal agriculture over a billion dollars each year. This project addresses the causes of a significant portion of these loses by examing the funtion of uterine genes regulated during early pregnancy. In addition, strategies are being developed for early diagnosis of these losses to facilitate re-breeding and increase reproductive efficiency.

14. ENHANCING THE EFFICIENCY OF A ARTIFICIAL INSEMINATION IN DAIRY CATTLE THROUGH A MODIFIED SYSTEMATIC BREEDING PROTOCOL

Investigators: Dalton, J. C.
Termination Date: 06/30/2007
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
OvSynch (GnRH-7d-prostaglandin-2d-GnRH-16 h-Timed AI) was designed to synchronize ovulation, thereby allowing timed AI of all cows without estrus detection. Nevertheless, OvSynch does not achieve 100% ovulation synchronization. Therefore, timed AI of all cows may not optimize conception rate per AI. Select Synch (GnRH-7d-prostaglandin-heat detection and AI) was designed to initiate a new follicular wave and lyse the corpus luteum to provide tighter synchronization of estrus than normally achieved through the use of prostaglandin alone. The primary limitation of Select Synch is the length of time recommended for heat detection (7 d), beginning one day prior to the prostaglandin injection and continuing for six days following prostaglandin administration. This project directly addresses the limitations of these GnRH-prostaglandin based protocols and may provide a new, more efficient, less costly protocol in which the efficiency of AI in lactating dairy cattle is increased. One commercial herd utilizing daily lock up, tail chalk, and once daily AI has completed their portion of the study. All cows (N = 293) were administered GnRH on d -7 and received tail chalk during daily herd lock up. Any cows determined to be in estrus according to chalk removal (roughened tailhead hair) prior to d 0 received AI immediately. Cows not detected in estrus by d 0 were administered prostaglandin and continued to receive tail chalk during daily herd lock up until d +2. Cows determined to be in estrus prior to and including d +2 received AI immediately. Cows not yet inseminated at 48 h after prostaglandin were randomly assigned to receive either 1) GnRH immediately and timed AI 16 h later (OvSynch), 2) GnRH and timed AI 64 h after prostaglandin, or 3) timed AI 64 h after prostaglandin. Conception rates (number pregnant divided by the total number inseminated) were 33.3% (30/90) for treatment 1 (OvSynch), 29.2% (26/89) for treatment 2, and 21.2% (18/85) for treatment 3. Nearly 10% of all cows (29/293) exhibited spontaneous estrus prior to d +2. The conception rate (number pregnant divided by the total number inseminated) for cows that exhibited spontaneous estrus was 34.5% (10/29). With limited data from one participating farm, there is clearly an advantage to performing heat detection while cattle are on a systematic breeding protocol, as evidenced by the 10 pregnant cows that resulted from heat detection, subsequent AI, and removal from the remainder of the protocol. Currently, there is a second commercial herd conducting the trial.

Impact:
As dairy producers manage larger herds to enhance their profitability through high volume, low cost production, labor efficient management strategies such as systematic breeding protocols, once-daily AI, and timed AI are becoming more common. This research incorporates current dairy management strategies while also addressing the limitations of current systematic breeding protocols. When completed, this research may provide a new, less costly protocol in which the efficiency of AI in lactating dairy cattle is increased.

15. REPRODUCTIVE PERFORMANCE IN DOMESTIC RUMINANTS

Investigators: Ward, A. C., England, J. J.
Termination Date: 09/30/2006
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Delineation of the microbial profile of potential bovine respiratory disease (BRD) organisms in a beef cattle herd was conducted by evaluation of guarded trachael swab samples collected from calves at 8 to 11 weeks of age (set A) and again at 29 to 32 weeks of age (set B). Potential bacterial pathogens were detected from 13 of 21 (62%) set A and from 100% of set B samples. Biovariants of Pasteurella trehalosi, Pasteurella (Mannheimia) haemolytica, and Pasteurella multocida were isolated from 10, 7 and 2 of set A and from 17, 12, and 4 of set B samples respectively. In addition Haemophilus somnus and Mycoplasma spp were isolated from 9 and 16 of set B samples respectively. Ten (62%) of the Mycoplasma isolates were identified by polymerase chain reaction procedures as M. bovis. Pasteurella trehalosi strains are recognized as potential pathogens of domestic sheep and as the most common members of the Pasteurellaceae family carried by wild ruminants but have rarely been incriminated as causes of BRD. However, P. trehalosi is being isolated from an increasing number of BRD cases evaluated in the CVTC diagnostic laboratory. The high number of P. trehalosi infected cattle in the test herd may be due to transmission from elk which fed with the cattle the previous winter. Biovariant 1 P. (M.) haemolytica, the most common bacterial cause of BRD was not isolated from any set A and from only 4 set B samples. Mycoplasma spp, particularly M. bovis, are known to be associated with BRD in a synergistic role with other organisms which were isolated from the test herd. In addition to bacterial BRD organisms, fluorescent antibody procedures detected bovine parainfluenza type 3 (PI3) virus, bovine respiratory syncytial virus, and bovine viral diarrhea virus in set B samples from 5, 2 and 1 calves repsectively. All samples were negative for bovine enteric coronavirus and bovine rhinotracheitis virus. Delineation of the microbial profile provides critical information for development and initiation of a more appropriate vaccination program for prevention of disease associated with BRD organisms present in this herd.

Impact:
Delineation of the microbial profile of potential BRD organisms provided critical data for designing an appropriate vaccination program to prevent disease in the test cattle herd. Detection of P. trehalosi from 81% of weaning-age calves, in contrast to a void of such reports in the literature, may be indicative of a greater than previously recognized potential for these organisms to cause disease in cattle, particularly in those which come into contact with wild ruminants.

Allocated resources IAES Program 2:

RPA	SY	PY/TY	Amount
301	2.55	1.0	$547,720
302	1.30	3.0	$509,772
305	0	0	$18,073
307	.14	1.0	$288,671
311	7.82	2.42	$1,694,933
312	1.19	0	$127,117
313	0	0	$0
Total	13.00	7.42	$3,186,286

IAES Program 3: Crop and Livestock Production Systems (RPAs 102, 308, 404 and 405). IAES Program 3 also contributes to **REE GOAL 1** and includes 4 research projects and approximately 1.5 SY of effort by faculty project leaders.

Performance Goals:
To develop marketing alternatives and product quality and consistency to meet consumer's demands. Loss of natural resources (e.g. soil and water) and agricultural inputs (e.g. chemicals) by Idaho food producers will be decreased.

Progress/Impacts:

1. CONJUNCTIVE IN-SEASON WATER AND NITROGEN MANAGEMENT FOR IMPROVED PRODUCTION
Investigators: King, B. A., Stark, J. C., Wall, R. W.
Termination Date: 08/31/2004
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Conventional center pivot irrigation management treats the field area as a homogeneous unit in terms of irrigation management and water application. Similarly, when nitrogen fertilizer is applied through the center pivot irrigation system, nitrogen requirements and application are also managed uniformly for the field area. Spatial variability in water and nitrogen requirement often develop throughout the growing season. The specific objectives of this project are to implement an independent spatially variable chemical application system on a center pivot currently equipped for spatially variable water application and use the center pivot system to evaluate the potential economical and environmental benefit of conjunctive, in-season, site-specific water and nitrogen application in potato production. The elements of the independent spatially variable application system are currently being designed and constructed for testing during the coming growing season.

Impact:
Documenting the economic and environmental benefits of conjunctive, in-season site-specific water and nitrogen application will foster commercialization of the technology.

2. INTEGRATION OF NEW TECHNOLOGIES FOR IMPROVED WATER MANAGEMENT

Investigators: King, B. A.
Termination Date: 06/30/2004
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Conventional irrigation management treats the field area as a homogeneous unit with equal irrigation application. The concept of site-specific irrigation management allows irrigation application to vary throughout the field area according to site-specific requirements. Site specific irrigation management was compared with conventional uniform irrigation management to evaluate the potential economic benefit in irrigated potato production. A closed-loop, variable rate control system developed for center pivots was used to implement site-specific irrigation management on the experimental field site. In 2002, one quadrant of the center pivot system was divided into eighteen arbitrary irrigation management zones. The management zones were grouped into blocks of two zones according to similar soil texture. Two irrigation management treatments were imposed in each block. Treatment one was site-specific irrigation based on a water balance model applied to the particular management zone. Treatment two was uniform irrigation whereby the water balance model was used to compute site-specific irrigation requirements but the irrigation amount applied was the average requirement for the nine irrigation management zones under this treatment. Treatment one was randomly assigned to the management zones in each block. The resulting experimental design was a randomized complete block with nine replications. Potato yield and grade was determined from three 30-ft row samples from each of the eighteen management zones. The average irrigation amount applied to the site-specific irrigation treatment was 0.5 inches less than that applied to the uniform irrigation management treatment. Average total and marketable tuber yield were greater under the site-specific irrigation treatment, but not statistically significantly greater. However, the percent U.S. No. 1 grade tubers was significantly greater ($p<.06$) under site-specific irrigation management. Based on a quality based processing contract price structure, gross income was $60/acre greater under site-specific irrigation management compared to conventional uniform irrigation management for this particular field site.

Impact:
Site-specific irrigation management has the potential to increase production efficiency while promoting water management practices that protect surface and groundwater from chemical contamination. The results demonstrate that site-specific irrigation management increases gross economic return by $60/acre relative to conventional irrigation management practices while protecting environmental quality.

3. MODIFYING MILK FAT COMPOSITION FOR ENHANCED MANUFACTURING QUALITIES AND CONSUMER ACCEPTABILITY

Investigators: McGuire, M. A.
Termination Date: 09/30/2004
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
The first series of experiments evaluated practical means to altering the fatty acid profile of milk fat in cows. We were able to enrich the Conjugated Linoleic Acid (CLA) content of milk fat in a dose-dependent manner by feeding calcium salts of a mixture of CLA. Milk fat was depressed in a dose-dependent manner similar to that observed with abomasal infusion of CLA. This demonstrates that a commonly used commercial protection of unsaturated fatty acids works for CLA. In collaboration with scientists at the University of Florida, we enriched milk fat with Eicosapentaenoic Acid (20:5 n-3)(EPA) and Docosahexaenoic Acid (22:5 n-3) (DHA) by feeding fish meal. Further, in collaboration with scientists at the University of Wisconsin, we determined that fat feeding interacted with level of forage to alter milk fat content and fatty acid profile, although the changes were smaller than expected. We also studied how changes in the rumen and source of substrate can alter biohydrogenation products by feeding cows either linoleic or oleic acid and collecting duodenal fluid. Results are under evaluation. A similar study was performed in growing beef cattle to determine ways to alter the fatty acid composition of beef. We failed to detect milk fat depression in rats or changes in the growth of litters from t10, c12 CLA. This may relate to the nutrient density of the diet resulting in fatter rats than in other studies. Our human lactation studies demonstrate that leaner women have milk fat depression when given a mixture of CLA while obese women do not respond. We will address this finding with another rat study looking at milk fat response to t10, c12 CLA in lean and obese rats. Finally, we have examined how a CLA-enriched cheese affects lactating women. Consumption of a CLA-enriched cheese enhanced CLA intake and concentration of human milk. However, CLA had no effect on the immune system in the lactating women. No alterations in cholesterol or lipoprotein status were found even though the women were consuming large quantities of cheese over an 8-wk period. We continue to investigate the role of lactation and diet on risk of mammary cancer. Using the Methyl Nitrosourea (MNU)-chemically induced cancer model, we have detected a protective effect of lactation and CLA on mammary tumorigenesis. Histological and biochemical changes within mammary tissue and tumors are under way. Further, it appears that lactation and CLA interact to protect against future cancer. Because of the interaction, two different mechanisms of protection are probable. We are evaluating this further in an implantable tumor model.

Impact:
Trans fatty acids, including conjugated linoleic acids (CLA), have unique biological effects in lactation. This is important, as the Institute of Medicine has recommended that food be labeled with trans fatty acid content. Milk, both human and bovine, contains trans fatty acids. We have demonstrated in lactating cows and women that milk fat synthesis is not altered similarly by all trans fatty acids. Clearly, grouping all trans fatty acids into one category may not be appropriate. We have demonstrated that CLA content of milk can be enriched through practical means. Also, milk fatty acids can be enriched with long chain polyunsaturated fatty acids, EPA and DHA, from fish oils. These additions improve the quality of milk for human health as well as benefiting the cow. Trans fatty acids and CLA from milk fat are beneficial to human health contrary to those trans fatty acids found in partially hydrogenated vegetable oils. These differences should

be considered as food labeling is proposed.

4. PHOSPHORUS, ZINC, IRON, MANGANESE, AND COPPER INTERACTIONS IN EAST-IDAHO POTATO CROPPING SYSTEMS

Investigators: Hopkins, B. G.
Termination Date: 06/30/2007
Reporting period: 07/01/2002 to 12/31/2002

Progress Report:
The first year of a phosphorus-zinc fertilizer interaction study was completed at a UI Aberdeen Research & Extension Station field with 15 ppm bicarb P, 5% excess lime, and 1.0 ppm DTPA Zn. The study consisted of five replications in a RCBD experimental design of all combinations of the following treatments: 0, 200, 400, 600 lbs-P2O5/acre and 0 and 20 lbs-Zn/acre. Significant responses were observed both for phosphorus and zinc fertilization, as well as a significant interaction between the two. Applying phosphorus at the recommended rate of 200 lbs-P2O5/acre resulted in a significant yield increase; however, excessive application [2 times the recommended rate (2x) or 3 times (3x)] decreased yields relative to the recommended rate. Applying zinc alleviated the negative effect of excess phosphorus, although only at the two highest high rates of phosphorus. Tuber quality differences were statistically significant in this study. It is apparent from these results that excess phosphorus does result in reduced potato yields and that zinc can correct the problem. More work is needed to elucidate proper rates and/or ratios of phosphorus and zinc for optimal potato production.

Impact:
The expected impact of this study is to determine if added micronutrient fertilizers ameliorate the effect of high rates of phosphorus fertilizer applied to potatoes and subsequent rotational crops (wheat and maize). If so, determine the appropriate rates and/or ratios of micronutrient fertilizers that need to be applied in combination with phosphorus to avoid yield and crop quality decline in areas of a field receiving more phosphorus than is optimal.

Allocated Resources IAES Program 3:

RPA	SY	PY/TY	Amount
102			
308	.75	2.0	$270,638
404	.80	1.0	$125,070
405	0	0	$17,941
Total	1.55	3.0	$413,649

IAES Program 4: Farm business management, economics and marketing (RPAs 402, 511, 601, 602, 603, 604 and 606). IAES Program 4 also contributes to **REE GOAL 1** and includes 10 research projects that incorporate 6.3 SY of faculty research effort.

Performance Goal(s):
Provide information to policy makers and to people dealing with ranch property concerning economic values and the part that is played by public grazing rights held by ranchers. Obtain greater knowledge of international trade as it is affected by policies and trade agreement combined with a better understanding of export practices to enhance the opportunity for Idaho and the Pacific Northwest to maintain a strong export market for agricultural products. Increase availability of production and market information for organic niche products, to help modest sized farms increase income potential. Develop a model for wheat price outlook for wheat producers in the Pacific Northwest and information permitting these farmers to market wheat more effectively and/or reduce price risk. Wheat quality will be increased through development of improved storage conditions.

1. GLOBAL TRANSPORTATION AND TECHNICAL BARRIER IMPACTS ON PACIFIC NORTHWEST EXPORT COMPETITIVENESS
Investigators: Jones, J. R.
Termination Date: 06/30/2003
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
A system was initiated using Equivalent Standard Axel Load (ESAL) coefficients to calibrate taxes on both a weight distance (WD) and registration system prorated by weight and mileage categories (RWM) on heavy trucks in conjunction with civil engineers in the National Institute of Advanced Transportation Technology Research Center at the University of Idaho. This was the first step in an effort to develop a tax structure to be applied as road finance requirements change and as the state converts from a weight distance tax framework to a registration system as dicated by the court settlement imposed on the state of Idaho. The conversion potentially has important implications for Idaho's agricultural sector since tax rates are effectively being doubled for carriers hauling agricultural commodities. American Association State Highway and Transportation ESAL tables estimating road wear by truck class will be compared with other more recently developed load equivalency factors.

Impact:
Idaho and Oregon have both had their weight distance taxes on heavy trucks legally challenged by the American Trucking Association. Expensive legal and political challenges because of random or arbitrary rules for imposing user fees on heavy trucks may be reduced by using ESAL calibrated scientifically based criteria.

2. NICHE FOR ORGANIC FOOD
Investigators: Foltz, J.
Termination Date: 06/30/2003

Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Work continues on USDA initiative for Future Agriculture and Food Systems (IFAFS) program grant - - "Understanding, Evaluating, and Improving Direct Marketing Strategies of Small Farms in the PNW." Part of this project looks at organic production. It is anticipated that approximately one-half of the 12 whole farm case studies to be developed for this project will be organic farms. One of the primary focuses of the case studies is to highlight commonly used direct marketing strategies, which include: farmers markets; Community Supported Agriculture; on-farm sales; and direct to retail. The project has also researched both software and manual data entry programs for farm management and analysis, many of which are highly applicable to organic operations. In addition, this project will also 1) develop an input-output model to attempt to quantify some of the impacts of small and organic farms on local economies in the region; 2) quantify the impact of farmers markets in the region (ID, WA & OR), including the value of organic produce sold via this manner.

Impact:
The organic food industry is cited as one of the top ten trends for food manufacturers and marketers. Food retailers are interested in determining the projected growth and impact of organic food demand on the grocery retailing industry. This project examines the impact of organic food production on Idaho's economy and other parts of the Pacific Northwest. Marketing implications for retailers will be outlined.

3. TRADE REFORMS, MARKET POWER, AND EFFECTS ON PROCESSED FOOD AND PRIMARY COMMODITY MARKETS

Investigators: Devadoss, S.
Termination Date: 06/30/2003
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Trade reforms strongly influences the U.S. food processing industries and agricultural commodity markets. Examining the characteristics of the food manufacturing sector are critical in analyzing the trade reform effects on processed foods industries and bulk commodity markets. Particularly, the noncompetitive behavior of the food processing firms needs to be considered. We undertook theoretical and empirical analyses of market size and consumer preference asymmetries to examine the implications of trade and trade polices for imperfectly competitive food manufacturing sectors. The results showed that the effects of trade reforms on imperfectly competitive product trade are counter intuitive if a significant portion of food trade is attributed to market size and preference asymmetries. For example, countries with smaller market gain relatively more from trade liberalization than countries with large markets because export market opportunities are greater for small countries than for large countries. In a theoretical study, We examined the curvature of production possibility frontier (PPF) of a model consisting of two final goods (one good is a processed food), one intermediate good (raw agricultural commodities), and two primary factors. One final good and the intermediate good are produced using primary factors, labor and capital. The second final good (processed food) is produced using labor and the intermediate input. Producers of the second final good exert oligopsonistic

market power on the intermediate input purchase. This model captures real world phenomena that are prevalent in the food processing industries. This study generates results that are not adherent to the standard two-sector Heckscher-Ohlin model. Some of the results that deviate from the H-O model are the relationships between factor prices and commodity prices, price-output effect, tangency between price line and PPF, and the curvature of PPF. In a follow-up study, we showed that some of the traditional trade theorems and trade pattern may be over turned if the factor intensity of the competitive sector falls between those of oligopsony and intermediate good sectors. In a another study, we compared the trend in the growth of the processed food sector to that of farm sector.

Impact:
This study will help to ascertain the market conduct for primary commodities and processed foods and identify the gains and losses from the trade reforms to agricultural raw commodity producers and food processing firms. Thus, the result of this research will also be useful to farmers, food processing and affiliate industries, export and import firms, and government agencies involved with trade policies.

4. ENGINEERING OPPORTUNITIES TO ENHANCE AGRICULTURAL PROFITABILITY

Investigators: Peterson, C. L.
Termination Date: 06/30/2004
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
The department currently operates five vehicles on biodiesel. The most recent is 'The Vandal Trolley', a 40 passenger bus fueled with B20 (20% biodiesel and 80% petroleum diesel). The trolley has 1,500 miles at 5.45 mpg. A 2001 Volkswagen 1.9 L TDI beetle fueled with yellow mustard B100 has a total of 9,982 miles at 46.2 mpg. Oil analysis data shows no abnormalities detected. Other vehicles include a 1999 Dodge 2500 Ram pickup truck (28,000 miles @ 15.5 mpg on B100 yellow mustard biodiesel), a 1994 Dodge truck (110,275 miles @ 18 mpg on B100) and a 3150 John Deere wheel tractor operated on B50 since 1985. The BAE crushing facility processed 10 ton of mustard seed including 7 tons of Ida Gold (24% oil and 56% extraction efficiency) and 3 tons of Pacific Gold (36% oil and 72% extraction efficiency), 550 gallons of oil was generated for biodiesel production and 8 tons of meal for PSES field testing. Emissions Data: The chassis dynamometer and a portable 5-gas analyzer (EMS Model 5001) were used in a study to correlate local NOx data with data from a study done at the LA-MTA with six biodiesel fuels. There was a definite positive trend between the two data sets showing that NOx tended to increase with increasing iodine level. These tests are part of a program to develop a local screening test for the effect of new oil seed varieties on emissions. Used Vegetable Oil from Deli's: The intent of this project was to consider the feasibility of using used vegetable oils in small amounts (1-10%) as a diesel fuel additive for small industrial engines used to power refrigeration units on food delivery trucks. The used vegetable oil and diesel fuel blends were evaluated by means of a fuel property analysis, an injector coking test, a 1000 hour engine durability test, and a stationary trailer test. Injector coking tests found that blends up to 5% used vegetable oil were the most promising. In a 1000 hour test with 10% used vegetable oil, there was a 6.7% loss in power and torque which was recovered when clean injectors were used

with the engine at the conclusion of the test. There was no abnormal engine wear found in lube oil analysis and no problems were reported from the inspection of major internal engine components. These results are based on a light load cycle typical of a refrigerated power unit and may not be representative of other loads. A refrigerated produce trailer has operated on a 10% blend of raw used oil and 90% #2 diesel for 488 hours. Fuel filter plugging during the winter months may be a problem. Residue Management: To limit soil erosion in the Palouse region, growers have been encouraged to adopt conservation practices that involve maintaining crop residues and using direct-seeding drills. High residue levels can interfere with the performance of direct-seeding drills. A hydraulically powered residue management tool was locally designed and is under test. The unit has performed well in low to medium high residue. Very high stubble conditions resulted in plugging. Staggering the openers on several ranks from front to back will likely solve this problem in all but the heaviest residue conditions.

Impact:
Bioenergy 2002 had Bioenergy professionals from around the world. The impact of that conference on development of Bioenergy technologies will be difficult to measure but can be considered significant. Biodiesel has become a big commercial venture with availability now in all 50 states. This industry can trace much of its roots to the University of Idaho program. Yellow mustard is a feedstock that has potential to reduce the cost of biodiesel especially if some of the uses for the co-products can be developed.

5. ECONOMIC ANALYSIS OF AGRICULTURAL PRODUCTION, SUPPLY AND POLICY IMPACTS

Investigators: McIntosh, C. S.
Termination Date: 06/30/2005
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Research in the general area of potato production economics is ongoing. Investigation of factors affecting yield quantity and grade was initiated. Specifically viral factors that impact potato production are being examined. Additionally the impact of drought on potato production risk is being examined. Work is continuing on the impact of public school quality on rural areas (versus urban areas).

Impact:
Research on potato risk magnitude and sources, and the additional risk brought on by drought will provide growers and processors information beyond what is included in the standard cost and return estimates. Cost of production data are used in economic impact studies and to evaluate the cost effectiveness of new production methods or technology, as well as to substantiate emergency pesticide registration requests. Cost and risk estimates are also needed when evaluating the benefits and costs of alternative crop rotations or management practices.

6. STUDY OF IDAHO FARMLAND VALUES, TRENDS, EXPLANATIONS, IMPLICATIONS

Investigators: Nelson, J.
Termination Date: 06/30/2005
Reporting period: 01/01/2002 to 12/31/2002

Progress Report**:**
Analysis of how development pressures affect farmland values was continued. Focus was on irrigated farmland in South-central Idaho. Research reported in last year's report indicated that Income multipliers (IM's), defined as the ratio of market value of farmland to gross land rent from agriculture, can be used to quantify the effects of development pressure on farmland values. Farmland values have two components: 1) agricultural value, and 2) development value increment which is the difference in actual value of a parcel and its agricultural value. Therefore, as development pressure increases, the IM increases, ceteris paribus. Income Multipliers (IM) were determined for farmland parcels sold in South-central Idaho by dividing total sale value of each tract by gross rent of the tract. Regression models were developed with IM's as dependent variables and agricultural and development related land characteristics as independent variables. Regressions were then run iteratively as parcels with low IM's were removed. Goodness of fit of models improved during this iterative process until all tracts with IM's less than 20 were eliminated. IM's less than 20 indicate that agricultural returns to land values are greater than 5% of land value, suggesting that little, if any, of the land value is attributable to development (all is attributable to agriculture). Tracts with IM's greater than 20 have an additional value that does not seem to be attributable to agriculture. The influencing factor is likely to be residential or commercial development. A Chow test was run which documented that parcels with IM's greater than 20 are from a different population than those with IM's less than 20. Development increment values were calculated for farmland parcels with high (>20) income multipliers. Regressions were run on development increments with agricultural and development related land characteristics as independent variables. Development increments were found to be explained by 'parcel sale price,' 'distance to nearest U.S., state or major county road,' and 'distance to nearest community.' So findings of this research indicate that: 1.)Farmland parcels that are under development pressure can be identified with statistical methods, 2.)Development increment values can be estimated for such parcels, and 3.)These development increment values can be explained by non-agricultural, amenity based variables. More research on evaluating development pressure on farmland is needed, especially to consider whether the ideas and methods presented in this report can be applied effectively in other areas. Preliminary work has been done to evaluate impacts of development pressure on farmland values in the Boise area of Southwest Idaho. This area has been under strong development pressure for about 10 years. Results of this preliminary research suggest that income multipliers and other coefficients that measure development pressure (possibly ratios of development increment values to total parcel values) can be used to effectively evaluate development pressure on farmland in an area under such high development pressure. Follow-up to this preliminary research is underway.

Impact:
Agricultural related determinants of values of farmland are well understood and well documented in the literature of agricultural economics. However, development pressure has substantial influence on farmland prices in many areas of the U.S. today, and such pressure is

increasing and less well understood. Information about determinants of farmland values should be of interest to land owners, appraisers, assessors, real estate brokers and developers. In addition, information about the impacts of development pressure on farmland, should be especially useful to local government officials and decision makers with nonprofit entities who are working to preserve farmland and agricultural areas by use of such mechanisms as purchasable development rights, transferable development rights and farmland trusts.

7. EVALUATING RISK MANAGEMENT ALTERNATIVES FOR THE PACIFIC NORTHWEST

Investigators: Makus, L.
Termination Date: 06/30/2005
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Alternative risk management tools were evaluated for a representative wheat farm in Latah County, ID. Alternatives evaluated included three crop insurance products (Multi-Peril Crop Insurance or MPCI, Crop Revenue Coverage or CRC, and Income Protection or IP), hedging, and selling on the cash market. Expected revenue was simulated over a 10 year period from 1990 to 2000. Results generally favored the hedging strategy, but differences were often insignificant. Insufficient data precluded an adequate assessment of return variability. Work is being conducted cooperatively with Washington State University on modeling 3 representative dryland grain production system in the Pacific Northwest (PNW). A utility maximization of portfolio income model is being used to evaluate risk management alternatives for the representative farms. The model includes all relevant crop insurance products and market-based instruments. Basis data for PNW cash white wheat are being updated and maintained. Alternative futures markets for hedging white wheat are being evaluated using a utility maximization approach. Wheat and feed grain outlook efforts are conducted periodically and published electronically at (http://wqww.ag.uidaho.edu/aers).

Impact:
This project has provided increased understanding and utilization of alternative risk management tools for agricultural producers in the region. Improved risk management decisions are expected to enhance profitability for PNW farmers, and ensure the sustainability of this region's agricultural production. Increased risk management skills can allow a reduction in support levels from traditional commodity programs.

8. FRUIT AND VEGETABLE SUPPLY-CHAIN MANAGEMENT, INNOVATIONS, AND COMPETITIVENESS

Investigators: Guenthner, J. F.
Termination Date: 09/30/2003
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Economic impacts of genetically-modified potatoes were analyzed for the US and two developing countries. The US effort included the publication of an article about consumer

acceptance. Historical consumption of three comparable products were modeled with logistic growth functions. Based on these models it was predicted that GM-potato product acceptance will begin to grow rapidly late in the 2000-2009 decade. The focus of GM potato economics in developing countries is in South Africa and Egypt. Preliminary results show positive potential benefits to potato producers and consumers in those two countries.

Impact:
The expected impact of this project is a better understanding of the economic impacts of genetically-modified potatoes in the US and in developing countries.

9. IMPACT ANALYSIS AND DECISION STRATEGIES FOR AGRICULTURAL RESEARCH

Investigators: Araji, A. A.
Termination Date: 09/30/2006
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
The State Agricultural Experiment Station database is updated to 2001. A set of new questioners were developed and distributed to all research faculty in the college. A personal interview is being scheduled. Return to investment and the benefits to consumers and prodders are estimated for the development and adoption of genetically modified potatoes. The waste utilization model was expanded to estimate the radius and number of acres needed for different rotation systems to efficiently utilize animal waste.

Impact:
The results of this study have far reaching impact on legislators and the agriculture industry to support agricultural research. The results of the waste utilization study will help farmers to reduce synthetic fertilizers use and lower the cost of production and help the agricultural identity to reduce phosphorous run off and environmental pollution.

10. NOVEL PROCESSING AND ISOLATION PROCESSES OF HIGH ERUCIC ACID OILSEEDS FOR VALUE-ADDED INDUSTRIAL PRODUCTS

Investigators: He, B.
Termination Date: 06/30/2007
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
This project was approved in July 2002 and preparatory work is in progress. A Food and Bioprocessing Research Laboratory (460 sq ft) is under development and will be completed by the end of the year. The PI has initiated a preliminary research project of isolating toxic chemicals from seed meals for value-added animal feed and biopesticides.

Impact:
Biodiesel from vegetable oils has been shown to be the best substitute for fossil-based fuels due to its renewable resource availability and environmental advantages. To enhance the

sustainability of biodiesel, we propose the integrated processing and utilization of oil seeds. Upon the accomplishment of the project, we would be able (1) to isolate erucic acid from high erucic acid oils, which could be used as a raw material for over 200 industrial products bearing biodegradability such as lubricants, surfactants, engineering plastics. Rest of the oil would be used for biodiesel production; and (2) to extract the toxic chemicals contained in the meal, which could be used as natural pesticides as replacement for synthetic ones. As a result of such integrated processing and utilization of oil seeds, we could produce multiple value-added products, which are or could be used to produce environmentally friendly industrial products, from plant/crop-based resources, meanwhile enhance the sustainability of biodiesel production from seed oils as a substitute of fossil fuels.

Allocated Resources IAES Program 4:

RPA	SY	PY/TY	Amount
402	.5	1.06	$173,164
511	0	0	$9,559
601	2.56	0	$295,037
602	.7	0	$66,376
603	.9	0	$170,989
604	0	0	$2,584
606	1.63	0	$142,767
Total	6.29	1.06	$860,476

Goal 2: A Safe and Secure Food and Fiber System

IAES Program 5: Food Safety and Quality (RPAs 503, 702, 711 and 712). IAES Program 5 is the only contribution to **REE GOAL 2**. This program area included 6 research projects and accounts for approximately 2 SY of faculty research effort.

Performance Goal(s):
A better understanding of flavor chemistry as related to sensory properties of selected red cultivars of grapes used in Idaho wines. Obtain additional information on the occurrence, effects and mechanisms of action of toxicants and antitoxicants in food. Improve diagnostic tests for microbial pathogens present in food and better education of the public on food safety issues.

Progress/Impact:

1. A NATIONAL AGRICULTURAL PROGRAM: CLEARANCES OF CHEMICALS AND BIOLOGICS FOR MINOR AND SPECIAL USES
Investigators: Hirnyck, R. E.
Termination Date: 09/30/2003
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
A survey of County Extension Educators, Specialists and commodity groups identified minor use pesticide needs for IR-4 priorities in Idaho. The Idaho Minor Crop Alliance also assisted with the prioritization process. The PI presented information about the IR-4 program and it's importance to minor crops at six grower meetings. The PI participated in the National Food Use Workshop, the National IR-4 and Western Region IR-4 meetings. The PI coordinates this project with the Western Region Pest Management Center. The Field Center Director participated in the National and Western Region IR-4 meetings, and the Western Region GLP training.

Impact:
The 2002 IR-4 magnitude of residue field trials conducted by the Idaho Field Center were: clethodim on succulent pea, bifenazate on succulent bean, trifloxystrobin on asparagus, buprofezin on cherry, indoxcarb on mint, bifenazate on potato (2 studies), famoxadone + cymoxanil on onion, thiamethoxam on barley (2 studies plus a processing study), diflubenzuron on barley, fenproximate on mint. These data will be used for future Section 18, 24(c) or Section 3 registrations for Idaho growers. The Zinc phosphide work done in the past is now in the 4th quarter FY03 EPA review schedule.

2. THE EFFECT OF DIET ON ESCHERICHIA COLI O157:H7 IN THE MICROBIAL FLORA OF THE RUMINANT G.I. TRACT

Investigators: Bohach, C. H.
Termination Date: 06/30/2002
Reporting period: 07/01/1996 to 06/30/2002

Termination Report:
Pre-harvest cattle management significantly impacts public health. Cattle transiently harbor E. coli O157:H7 in their gastrointestinal tract and many human infections result from ingestion of contaminated bovine food products. The economic impact of E. coli O157:H7 contamination is enormous and has included product recalls and plant closures. Human infections with Escherichia coli O157:H7 result in hemorrhagic colitis that can progress to the hemolytic uremic syndrome, a life threatening sequelae that is the most common cause of acute renal failure in children. A report by others concluded that cattle fed grain diets have large numbers of acid-resistant total generic E. coli in their feces, while hay-fed cattle do not. They also concluded that feeding cattle hay diets would reduce the risk of food-borne E. coli O157:H7 infection for humans. To test this hypothesis, we compared titers, persistence, and bacterial acid resistance of generic coliforms and E. coli O157:H7 from various gastrointestinal tract (GIT) sites of cattle fed grain or hay. Mature Angus steers, dually cannulated into the rumen and the duodenum were inoculated with E. coli O157:H7. Aliquots of digesta from the rumen, duodenum, and rectum were cultured directly or acid shocked (pH 2.0) and then cultured to determine acid resistance. E. coli O157:H7 from hay-fed or grain-fed cattle were similarly acid resistant in all GIT locations. In contrast, generic coliforms from the rumen and rectum of hay-fed animals were more sensitive to an acid shock than coliforms from those GIT locations in grain-fed animals. E. coli O157:H7 colonized the most distal region of the GIT and persisted in rectal samples in many animals during the month-long study, but was cultured from the rumen and the duodenum for just days

post-inoculation. Titers in the upper GIT did not predict titers or persistence of E. coli O157:H7 in rectal samples. Grain-feeding or hay-feeding did not affect survival of E. coli O157:H7 in the rumen, or its passage through the abomasum (pH 2.0) to the duodenum. These data showed that non-pathogenic coliforms were different than pathogenic E. coli O157:H7 and support the hypothesis that the environment of the bovine GIT induces E. coli O157:H7 acid resistance, independent of animal diet.

Impact:
Our work suggests that pre-harvest dietary changes that feed cattle hay rather than grain will not impact the problem with E. coli O157.

3. IMPROVE FOOD SAFETY THROUGH DISCOVERY & CONTROL OF NATURAL & INDUCED TOXICANTS & ANTITOXICANTS

Investigators: Exon, J. H.
Termination Date: 9/30/2003
Reporting period: 10/01/1997 to 09/30/2002

Progress Report:
Since the initiation of this project in 1997, we have examined the effects of several natural food compounds on development of preneoplastic markers of colon cancer and/or immune functions in a rat model. The immune functions tested include B cell-mediated antibody response, T cell mediated delayed-type hypersensitivity and non-specific cell-mediated natural killer cell activity. Initial testing of a commercially available echinacea (ECH) preparation (NE), marketed as an immunostimulator, showed no enhancement of immune functions in our rat model, however, a nonsignificant dose dependent decrease in natural killer cell cytotoxicity was apparent following 225 or 50 mg/kg BW ECH for 6 wks in male rats. Exposure of both sexes of rats to NE (225 mg/kg) for 2 wks, showed no stimulation of antibody response in the male rats and a significant decrease in antibody response in female rats. Testing of a different batch of NE and two ECH products from local herbalists (LH) showed no effect on antibody activity from LH and a significant reduction in antibody response in NE fed rats. An age-related reversal of enhancement of antibody response in rats fed curcumin, found in the spice tumeric, suggested our model should include older rats. Evaluation of mid-aged and young rats in our colon carcinogen model has shown that significantly more aberrant crypt foci (ACF) develop in the colons of 52 wk compared to 8 wk old female and male rats. A significant increase in the number of ACF present in the proximal region of the colon was also present in the 52 wk old rats of both sexes. We have expanded our animal model to include mid-age rats. This allows evaluation of food compounds on immune functions and colon cancer in an animal population that is at higher risk for colon preneoplasia and impaired immune function. In older rats, dietary sphingomyelin (SPH), a compound in dairy products, fed after the initiation of ACF development, significantly reduced the number of larger ACF and the number of ACF in the proximal colon. This colonic region is also more susceptible to colon cancer in humans. Colonic crypt cell proliferation was decreased by SPH. Immune functions were similar in rats fed vehicle or SPH. Initial results from an expanded investigation of SPH and two other milk derived compounds, conjugated linoleic acid (CLA) and butyrate, fed singly or in combination, have shown that natural killer cell activity was increased in rats fed CLA or a combination of all three compounds. The effect of these compounds on ACF numbers is still under evaluation. We have also examined the effect of d-

alpha tocopherol succinate (VE) on ACF in 20 and 2 mo old female rats. The older rats fed VE had significantly fewer large ACF (> 3 crypts per foci) than old rats not fed VE. VE did not produce a significant reduction in ACF in young rats. VE levels in the colon were elevated in both 20 and 2 mo old groups, however, only the 20 mo rats had significantly elevated gamma-tocopherol in the colon. The results of our investigations suggest that the older rat model may be particularly useful in determining effective dietary strategies for health maintenance in older people.

Impact:
The American public spends a substantial amount of money on products containing Echinacea based on advertised claims of immunostimulatory actions of these products. The finding of no effect or a negative effect of Echinacea on some immune functions suggests that the health benefits of Echinacea products may be overstated and even potentially harmful in some cases. Development of an older rat model provides a valuable tool for evaluation of dietary compounds that may reduce colon cancer incidence in older individuals, a group at high risk for colon cancer development. Several compounds that were evaluated differ in effectiveness in older versus young rats, both on immune functions and the development of colon cancer markers. Furthermore, the aging rat provides a useful tool for identification of age related alterations in biological mechanisms and the effect these alterations may have on possible health promoting actions of dietary compounds. The retention of the gamma form of vitamin E in the older rats supplemented with the alpha form of vitamin E may be important in enhancing the effectiveness of vitamin E in colon cancer chemoprevention in older populations.

4. STORAGE MANAGEMENT FOR IMPROVED POTATO QUALITY

Investigators: Kleinkopf, G. E.
Termination Date: 06/30/2006
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Six potato cultivars, Russet Burbank, Alturas, Summit Russet, Bannock Russet, A8893-1, and A9014-2, were evaluated for best management storage recommendations. Dormancy characteristics, sugar concentrations and sprout suppression were measured for each cultivar at each of three storage temperatures. This information is valuable for determining storage requirements and environmental conditions necessary to provide the best storage for expected end uses. This study requires three years of replicated evaluations to develop a best management program for each variety. Disinfestation of storages and incoming potatoes is important for helping control disease development. Two products evaluated, chlorine dioxide and hydrogen peroxide/peroxyacetic acid materials, were shown to be ineffective in reducing the quantity of tuber decay in storage. Application methods and concentration of applied products failed to produce adequate pathogen control. Other disinfestants are being evaluated. Sprout control with naturally occurring materials compared to CIPC were tested for efficacy. Treatment of potatoes with high energy electrons was successful in preventing sprout development for 12-18 months. This treatment provided by linear accelerators may prove to be an important alternative to chemical control of sprout growth in storage. Two products, Biox A (eugenol) and MCW 100 (stabilized hydrogen peroxide) were also capable of suppressing sprout growth similar to CIPC. Each of these products must be applied frequently to maintain sprout free conditions for long

term storage requirements. Variable frequency drive (VFD) fan speed controllers can improve potato tuber quality in storage while saving up to 30 percent of the power requirements. By controlling the storage environment carefully with VFD's, a storage manager can improve the environmental conditions for long term potato storage. These power savings coupled with the quality improvements can result in dollar savings equivalent to the equipment costs in as little as one or two years.

Impact:
Benefits derived from this project target potato industry personnel, including growers, packers, processors and other academic units to assist the potato industry in solving problems concerning maintaining quality in long-term storage.

5. ANTIVIRAL ACTIVITY OF SHIGA TOXIN TOWARDS BOVINE LEUKEMIA VIRUS

Investigators: Bohach, C. H.
Termination Date: 06/30/2007
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Interestingly, despite intensive investigations, an explanation as to why cattle carry Shiga toxin-producing E. coli has not surfaced. We tested the hypothesis that Stx has anti-viral properties for bovine viruses by assessing the impact of Stx type 1 (Stx1) on bovine peripheral blood mononuclear cells (PBMC) from cows infected with bovine leukemia virus (BLV). PBMC from BLV-positive animals invariably displayed spontaneous lymphocyte proliferation (SLP) in vitro. Stx1 or the toxin A subunit (Stx1A) strongly inhibited SLP. Toxin only weakly reduced the pokeweed-induced proliferation of PBMC from normal (BLV-negative) cows and had no effect on concanavalin A or interleukin-2-induced proliferation. The toxin activity in PBMC from BLV-positive cattle was selective for viral SLP and did not inhibit cell response to pokeweed- or interleukin-2-indcued proliferation. Antibody to virus or Stx1A were most effective at inhibiting SLP if administered at the start of cell culture, indicating that both reagents likely interfere with BLV-dependent initiation of SLP. Stx1A inhibited expression of BLV p24 protein by PBMC. The Stx molecular motifs required for antiviral activity were identified and a mechanism of Stx action on virally infected cells is suggested. Using inhibition of BLV-dependent spontaneous lymphocyte proliferation as a measure of antiviral activity, we showed that Stx type 2 had antiviral activity similar to Stx1. Enzymatic and antiviral activities of three Stx1 A chain (Stx1A) mutants, deficient in enzymatic activity or aspects of receptor-mediated cytotoxicity, were compared. Using protein synthesis inhibition to measure enzymatic activity, the mutant E167D was 300-fold less catalytically active than wild-type Stx1A, was minimally active in antiviral assays, and did not inhibit synthesis of viral proteins. Two Stx1A mutants, A231D-G234E and Stx1A1, enzymatically active but unable to kill cells via the classical receptor-mediated route, had undiminished antiviral activity. Although binding of radiolabelled Stx1A to bovine blood cells or to free virus was not detected, flow cytometric analysis showed that the number of BLV-expressing cells were specifically reduced in cultures treated with Stx. These unique and rare lymphocytes were highly permeable to 40 and 70 kDa fluorescent dextrans, indicating that direct absorption of toxins by virus-expressing cells was a potential mechanism of target cell intoxication. These results supported the hypothesis that Stx-producing Escherichia coli

colonization of the gastrointestinal tract may benefit ruminant hosts by the ability of Stxs to exert antiviral activity.

Impact:
Our data suggests that E. coli Shiga toxin has potent anti-viral activity and may serve an important role in bovine leukemia virus (BLV)-infected cattle by inhibiting BLV replication and thus slowing the progression of infection to its malignant end-stage. In addition, since cells are targeted, not by a specific virus, but by increased cell permeability, a general property subsequent to viral replication, the antiviral effects of Stx may have broad applications to many viral infections and to species other than bovine.

6. CHARACTERIZATION OF A GROWTH-STIMULATORY PROTEIN WITH PROSPECTIVE USE IN THE REPAIR OF METABOLICALLY-INJURED FOOD-BORNE PATHOGENIC BACTERIA

Investigators: Yuksel, G. U.
Termination Date: 06/30/2007
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Bacteria associated with marine macroorganisms excrete a variety of biologically active compounds. Our objective was to characterize one such compound. The bacterium Pseudoalteromonas sp. strain MMM 18 was isolated from the thallus surface of Laminaria japonica of Japan Sea, Russian cost. The biological activity of the metabolic products of MMM 18 was investigated through seed germination, marine algae-bacteria interaction and bacterial growth experiments using young plants of Laminaria japonica, seeds and germs of Raphanus sativus, Triticum durum, Soya ripida, Ovena sativa, Pisum sativum and Brassica juncea, cells culture of ginseng callus R-1, Escherichia coli K-12, Staphylococcus aureus, Pseudomonas aeruginosa, Micrococcus luteus and Bacillus subtilus. Microbial exo-metabolites were separated by ultra-filtration (pore size of 50 A), gel-filtration and hydrophobic interaction chromatography and PAGE. Research findings indicated that MMM 18 is capable of increasing longevity and improving state of marine algae. Culture supernatants of the actively growing MMM 18 and its purified fractions increased seed germination (up to 100% with initial ability of 40-70%), germ length (up to 230%) and the biomass of ginseng callus cells (up to 48%). The admission of the culture supernatants to selected media provoked stimulatory effect on different phases of bacterial growth. Spectrophotometric scans (200-700 nm) of MMM 18 cultural liquid revealed a single sharp peak with the maximum absorption at 280 nm during the transition stage from the logarithmic to the stationary growth phase. When subjected to heat, MMM 18 cultural liquid did not exhibit any of the biological activities that it exhibited initially. The biologically active compound secreted by MMM 18 was determined to be a water-soluble protein with four subunits and a molecular mass of about 240 kDa. The bacterium Pseudoalteromonas sp. strain MMM 18 excretes a biologically active protein that is a heat-labile secondary metabolite with a large molecular mass. The compound has a stimulatory effect on growth of certain bacterial and plant cells. Its stimulatory effect on growth of plants seems to be similar to those of auxins. The current research aims to obtain a good understanding, at the biochemical and molecular levels, of this growth-stimulatory protein that has the prospect of being used as a repair agent for the metabolically-injured food-borne pathogenic bacteria.

Allocated Resources IAES Program 5:

RPA	SY	PY/TY	Amount
503	1.0	.89	$235,606
702	0	0	$0
711	.2	0	$169,521
712	.75	2.0	$664,231
Total	**1.95**	**2.89**	**$1,069,358**

Goal 3: A Healthy, Well Nourished Population

IAES Program 6: Human Health and Nutrition (RPAs 504, 701, 703 and 722). IAES Program 6 represents the IAES contribution to **REE GOAL 3** and includes 8 projects enrolled in CRIS involving 1.2 SY of research effort.

Performance Goal(s):
Increase understanding of motivators and barriers, attitudes and knowledge about consumption across age, gender, and selected minority groups. To obtain a better understanding of how natural chemicals in the diet interact with cancer processes.

Progress/Impacts:

1. DEVELOPMENT OF CHILDREN'S SKILLS AT MEALTIMES IN GROUP CARE SETTINGS
Investigators: Fletcher, J. W.
Termination Date: 06/30/2002
Reporting period: 07/01/1996 to 06/30/2002

Termination Report:
The purpose of this project was to study development of eating traits in young children in group settings, specifically child care. Results of studies indicate the following. 1. Children as early as age 24 months are developing skills for group participation in serving self and maintaining reasonable food safety; 2. Young children participate in mealtimes, using acute auditory awareness, though response to auditory cues may be delayed to a greater degree than is found in adults. 3. Using Mozart compositions as an environmental factor at mealtimes, did not show an effect on children's mealtime behaviors, or food consumption. 4. Tasting and looking are sensory modalities that give children experience with new foods. Using a game-like modality for introducing tasting and looking opportunities initially encourages trying the new foods, though after five to seven trials, the novelty wears off and children resort to other methods for determining whether or not to try unfamiliar foods.

Impact:
These studies resulted in a constellation of practical, strategy oriented products such as developmental characteristics of children in relation to food safety, impact of environment and teacher roles have been disseminated widely. A major impact of this research was development of a nationally delivered satellite course for child care providers and Head Start staff. The course was also disseminated via web and video. The web site developed from the project has had over 25,000 hits, with downloads of materials for training child care providers and Head Start staff.

2. FACTORS INFLUENCING THE INTAKE OF CALCIUM RICH FOOD AMONG ADOLESCENTS

Investigators: Gabel, K. A.
Termination Date: 09/30/2002
Reporting period: 10/31/1996 to 09/30/2002

Termination Report:
Last year, Idaho surveys for multi-state project, W-191 were provided to New Mexico State University for analysis. The surveys were scanned, checked for errors and data are now ready for distribution to the investigators. The W-191 instrument was also used in a dissertation project in which the Ph.D. candidate assessed bone health using qualitative ultrasound technology, in addition to identifying adolescent risk factors for osteoporosis.

Impact:
This was the first study using qualitative ultrasound scan of the heel to identify multiple risk factors in adolescent females. It was also one of the first to demonstrate a relationship between stiffness index and everyday physical activity, in addition to calcium intake and body weight in adolescent girls. It appears some of the risk factors of osteoporosis associated with adults apply to adolescent girls.

3. CHILDHOOD FEEDING PRACTICES

Investigators: Branen, L.
Termination Date: 06/30/2003
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
The overall purpose of this research is to expand the knowledge base for determining best practice for feeding young children in group settings. A replication of Dr. Leanne Birch's study of preschool children's preference for novel foods was completed. One group of preschool children looked at novel foods, while another group looked at and tasted the food. Results indicate that tasting and looking increased the children's preference for a novel food, though after five exposures, the effect decreased. These results differ from Birch, who found that 15 tasting exposures were needed in order to increase preference. Analysis has been completed of interviews of 50 childcare providers, who were asked about their group feeding practices and the factors that influence them. The results will serve as the basis for a multi-state survey of over 3000 childcare providers. A qualitative study of childcare providers' infant feeding practices has been initiated. This study includes both observation of and interviews with childcare providers.

Impact:
The results of these studies serve as the basis for feeding workshops. Specifically, we presented a five-hour workshop to 180 childcare providers in Redding California. We also presented three feeding workshops at the Annual Child Care Food Program Sponsors' Conference in Anaheim. In addition, we presented at the CACFP National Professional Association Conference in New York. As a result, more childcare centers are following best practice in feeding children. Based on our research, we maintain a feeding website that serves as a resource for those who teach others about feeding young children in childcare and Head Start programs. The site has received over 25,000 hits, and several of the handouts available at this site have been downloaded over 8000 times.

4. EFFECT OF TEAM NUTRITION CLASSES ON SELECTION AND CONSUMPTION OF SCHOOL LUNCH ITEMS
Investigators: Raidl, M.
Termination Date: 06/30/2004
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
In order to get children to change their eating habits, it is important to know their current eating habits. The traditional 24 hour recall, Food Frequency Questionnaire and 3-7 day Food Records tend to produce inaccurate and inconsistent data. Therefore, a new way to collect information on eating habits was tested by providing students with a variety of food samples as part of their nutrition lesson, and determining if these foods were eaten at home. Classes and activities from the Team Nutrition Community Nutrition Action Kit were chosen that focused on fruit, vegetables and grains. Food intake sheets were developed to record eating habits information. Parents have stated that it is difficult to get children to try different foods, so this project incorporated three different strategies in getting children to consume many different food samples. The results indicated that fruits consumed by most children (89-100%) at home were bananas, watermelon, grapes, and strawberries. Fruits consumed less frequently (41-52%) at home were avocado and mango, and those consumed rarely (17%) were papaya. Vegetables were consumed by a smaller percentage of children than fruits. The vegetables consumed by a majority (>50%) of children at home were cucumber, carrot, tomato, and cauliflower. Very few children (2-4%) had ever tried bok choy or jicama prior to these classes. The majority (>50%) of children consumed 6 wheat samples (graham crackers, bread rolls, whole wheat bread, pasta, pretzels, wheat thins), 3 oat samples (Cheerios, Toaste Oats cereal, oat granola bar), 2 corn samples (tortilla chips and popcorn), and 1 rice sample (Rice Krispies cereal). Grain samples not consumed by a majority of children included rice cakes, rye bread, and rye crackers. The three instructional strategies that were successful in getting children to try new food samples were: (1) introducing familiar with unfamiliar foods; (2) hands-ona ctivities, and (3) linking nutrition concepts to food samples. Instructors estimated that 90% of the fruit, vegetable, and grain food samples were tasted. Future plans include providing families with activities that can supplement the classes and instructional strategies on how to get their children to try new foods. Nutrition education needs a greater emphasis in the grade schools since advancement to high school causes a further decline in nutrient intake. Schools and parents need to coordinate their efforts since studies indicate that children receive 90% of their nutrition information from teachers and 77%

from parents.

Impact:
The expected impact is that children and parent's eating behaviors will improve. Families influence their children's eating habits and children are more likely to try and accept new foods if this is a positive experience and develop healthy food habits.

5. THE ROLE OF CULTURE IN INFANT FEEDING PRACTICES

Investigators: Houghton, M.
Termination Date: 06/30/2004
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Hispanic women are known to have a high rate of breastfeeding when they are in their native countries. Unfortunately, there is a marked decline in breastfeeding rates when these women move to the United States. The goal of this project is to retain the practice of breastfeeding in this population through effective education. In that effort, Hispanic women who participate in WIC in Central Washington and Southern Idaho were surveyed to determine their infant feeding practices and their beliefs about breastfeeding versus bottle feeding. WIC dietitians at the same clinics were also surveyed to determine what problems they have observed in the Hispanic population related to infant feeding. The results of the survey are being used to create a web site containing educational materials in Spanish that addresses specific concerns and problems identified in the study population. A summary of the survey results follows. In the Hispanic survey, 59% of the mothers reported that they breastfed their infants, while 22% combined breastfeeding with bottlefeeding. Seventy-four percent stated that breastfeeding is best for the baby and 78% said it was the most convenient way to feed the baby. Those who did not breastfeed gave several reasons: Insufficient breastmilk; had to return to work or school; sore nipples. Most reported (55%) that the infant feeding practices are different in the US compared to their homeland. Two specific comments made: "Everyone breastfeeds their infants in Mexico. In contrast, it is not a common practice in the USA." "In the USA, infants are given a bottle immediately after birth in hospitals." Several felt they needed more information about how to hold an infant while breastfeeding and many also requested weaning information. The WIC dietitians had similar observations. Fifty-one percent of the dietitians reported that breastfeeding was preferred among their Hispanic clients and 63% stated that Hispanic mothers consider colostrum to be good for their infants. When asked what traditional beliefs the Hispanic mothers had regarding infant feeding, several were reported. "When there is trauma, mothers stop breastfeeding and wean their infants immediately." "Breast milk goes bad when mothers are angry." If a mother is sad when breastfeeding, she will pass the sadness to the infant who will then fall sick." "If a mother is upset, she cannot produce milk." This is only a sampling of some of their beliefs. It is clear that Hispanic women need to be educated about these specific myths and misconceptions. With this in mind, educational web pages are being designed, in Spanish and English, to address these issues and other problems identified in this study. The pages will be printable so that WIC dietitians will be able to give handouts from the web during counseling sessions. These web pages should be ready to use by May 2003.

Impact:
WIC dietitians will be able to educate Hispanic women about breastfeeding more successfully, specifically addressing misconceptions and myths that this population has about infant feeding. With more appropriate education, Hispanic women will continue to breastfeed at a higher rate than is normally observed after immigration to the USA.

6. PARENTS' INTENTIONS AND BELIEFS TOWARDS ENCOURAGING THEIR CHILDREN'S PARTICIPATION IN THE NATIONAL SCHOOL LUNCH PROGRAM
Investigators: Lambert, L.
Termination Date: 06/30/2006
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Project I: Research is being conducted in Idaho using focus group discussions with elementary school teachers, students, and parents to determine perceptions, practices, and barriers to implementing a Healthy School Nutrition Environment (HSNE) and to determine perceptions, practices, and barriers to students' school breakfast participation. Focus group discussions have been completed in four of five schools selected for study. Focus group discussion will be completed in the fifth school by February 2003. All completed focus group discussions have been transcribe and will be analyzed with the assistance of Ethnograph software. Analyses will be conducted using guidelines developed by Krueger & Morgan (1997) and will be completed by April 2003. A written report of findings will be submitted to all funding agencies by June 2003. Project II: A survey instrument has been developed and pilot tested. This survey instrument is designed to 1) measure school foodservice directors', elementary teachers' and principals' perceptions, practices, and barriers to providing nutrition education to elementary school students, 2) compare differences among foodservice directors, elementary teachers, and principals in their perceptions, practices, and barriers to providing nutrition education to elementary school students, and 3) assess the work environment and support system for foodservice directors to participate in nutrition education of elementary school students. The survey instrument will be mailed to test subjects in two states, Idaho and Arkansas, in January 2003.

Impact:
Project I: The results of the focus group discussions will provide child nutrition professionals insight into barriers in developing and implementing a Healthy School Nutrition Environment (HSNE) in Idaho's elementary schools. Focus group discussions will provide information regarding what teachers, parents, and students perceive as important aspects that should be included in the development of a HSNE. Project II: The nutrition education survey will provide insight as to the existing practices, perceptions, and barriers to incorporating nutrition education into school curriculum. This information will allow state nutrition education specialists to develop materials and education programs to better meet the needs of educators and foodservice directors in Idaho and Arkansas.

7. IMPROVING CONSUMER FOOD SAFETY HABITS: REMOVING BARRIERS TO THERMOMETER USE
Investigators: McCurdy, S. M.
Termination Date: 06/30/2006
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Two brochures, "Why Use a Thermometer in Ground Meat" and "Using a Food Thermometer in Thin Meat", were developed and tested with four consumer focus groups (April 17 and 23, June 4 and 12, 2002). The suggestions made by the focus group participants were valuable in re-designing the brochures. Based on feedback obtained, the information in the brochures has been combined into a single brochure on using an instant-read food thermometer when cooking small meat items. The brochure will be printed in 2003. During 2003, the brochure and a digital thermometer will be mailed to randomly selected Idaho residents who agree to participate in the survey. Consumers receiving the mailing will be surveyed 1 and 3 months after receiving the education intervention to ascertain its effect on thermometer use and intention.

Impact:
Consumers in Idaho will increase their use of instant-read thermometers when cooking meats, resulting in a decrease in foodborne illnesses associated with undercooked meats.

8. HUMAN CYTOMEGALOVIRUS-INDUCED CHROMOSOMAL DAMAGE: POTENTIAL ROLE IN SENSORINEURAL MANIFESTATIONS OF THE CONGENITALLY INFECTED INFANT
Investigators: Fortunato, E. A.
Termination Date: 06/30/2006
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
We have performed initial studies using the comet assay on mock and virus-infected fibroblasts. Previously, we had only qualitative analysis of the data. We now have performed some initial quantitative analysis using VisComet software. Mock, viral, mock+UV and viral+UV samples at the given timepoints of 2,6 and 24 hours post-irradiation in cells irradiated at either 12 hpi or 48 hpi were analyzed. Comets were analyzed for % DNA in the tail, which is a measure in UV-irradiated cells of the ability of the cell to cleave UV dimers using the Nucleotide Excision Repair machinery. Experiments performed in cells irradiated at 12 hpi did not show dramatic differences between mock and virus-infected cells in their ability to repair UV dimers. This is what would be expected if our theory concerning the importance of sequestration of cellular proteins into the replication centers is correct. However, virus-infected cells irradiated at 48 hpi showed significant differences in their rate of response to damage and their level of residual damage versus their mock+UV counterparts. Virus-infected cells began repair at a more rapid rate, yet harbored more residual damage at the 24 hp irradiation timepoint. We have now begun to expand our assay conditions to include the use of alkaline electrophoresis (more sensitive) and the testing of lower UV doses. The trend for an increased amount of damage in the viral+UV samples that remains unrepaired at late times is still apparent using the more sensitive method. The use of a lower UV dose of 50 J/m2 (instead of 75), has alleviated any residual damage in the

mock+UV cells, and by 24h post irradiation, these cells have completely repaired their DNA. Our next tests will be to try irradiation at earlier times, to try and alleviate at least some of the viral replication phenomenon. Localization of both 6,4 photoproducts (6,4 PPDs) and cyclopyrimidine dimers (CPDs) in cells irradiated at 48 hpi revealed differences in the ability of mock and virally infected cells to repair these subsets of dimers. The removal of exogenously introduced dimers in mock and virus-infected cells was assessed. Mock cells were faster at repairing the 6,4 PPDs. By 4 hp irradiation, mock cells had repaired most of the 6,4 PPDs, whereas at 24 hp irradiation, there were still some residual dimers within the virus-infected nuclei. While both mock and virus-infected cells had residual CPD at 24 hp irradiation, there was distinct localization of the dimers in the infected cells to the periphery of the nucleus where the cellular DNA resides at this time post infection and NOT in the viral replication centers. This leads us to believe that there is preferential removal of dimers from the viral DNA. We proposed to use the g H2AX antibody to determine whether the virus is inducing breaks in both G0 and S phase infected cells. This antibody has now been successfully tried and we are visualizing very distinct foci in cells infected in S phase with HCMV. The foci are seen at 3 hpi in approximately 20-30% of the cells.

Impact:
This research has shown that the cells infected with human cytomegalovirus are less capable of repairing their own DNA if they are damaged after infection. This discovery highlights the fragile nature of cells infected with HCMV and may shed light on the mechanism behind the induction of birth defects and possibly cancer that can be induced by this virus.

9. STAFF ROLES AT MEALTIMES IN GROUP CARE FOR CHILDREN

Investigators: Fletcher, J. W.
Termination Date: 06/30/2007
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Video taped observations are being analyzed for a study of behaviors of young children when teachers sit at the mealtime table and eat with children versus when the children sit at the tables alone. A second study is underway to survey child care staff regarding influences on their feeding practices in center mealtimes. Interviews of 50 child care providers have been completed and analyzed. A questionnaire will be developed in Spring 2003 to survey 3000 child care staff throughout the west. A third study is underway using a qualitative design to study infant caregiver roles in feeding infants in child care center programs. This study will include interviews of infant caregivers, and observations in their centers. Qualities will be characterized for future studies.

Impact:
This project will impact child care staff and the application of strategies for feeding children at mealtimes. The project will result in better understanding of the training needs for child care staff to effectively feed children at mealtimes. An outcome of that understanding is that trainers and supervisors of child care staff will have greater knowledge about how to educate and support staff. Such training will directly impact strategies used by caregivers to help young children and their families achieve healthy eating habits.

Allocated Resources IAES Program 6:

RPA	SY	PY/TY	Amount
504	.23	0	$28,696
701	0	0	$43,304
703	1.0	0	$331,105
723	0	0	$120,919
Total	1.23	0	$524,024

Goal 4: Greater Harmony Between Agriculture and the Environment

IAES Program 7: Soil, Water and Air Quality Conservation and Sustainable Agriculture Practices (RPAs 101, 102, 104, 111, 112, 132, 133, 135, and 215). IAES Program 7 contributes to REE GOAL 4 and is the IAES's second largest research program area. This program area has 23 research projects and encompasses 9.8 SY of faculty research contribution.

Performance Goals:
Reduced erosion, nutrient depletion, salination and toxification of agricultural soils coupled with increased adoption of precision soil and crop management techniques. Efficient application and utilization of water, fertilizer, pesticides, and other crop and soil amendments for biological control of pests. To meet the water quantity and quality needs of different constituents on a scientific basis through sustainable practices.

Progress/Impacts:

1. POLLUTANT TRANSPORT MODELS TO DETERMINE CRITICAL SOURCES AREAS IN WATERSHEDS
Investigators: Boll, J.
Termination Date: 06/30/2003
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Research was conducted to validate modifications made in the Soil Moisture Routing (SMR) model based on research at the Troy Research Site (TRS). Results from the TRS showed very good agreement between perched water table measurements at 99 locations within a small 1.7 ha watershed. The relationship between saturated hydraulic conductivity and depth proved to be exponential, but the values of the saturated hydraulic conductivity are up to one order of magnitude larger than those found in the Soil Survey database. The drainable porosity for the silt loam soils of the area was on the order of a few percent. Application of SMR to the larger Paradise Creek watershed showed generally good agreement with streamflow measured below a forest, below a forest-agriculture area, and below a forest-agriculture-urban area. In all areas, the drought year 2000 was overpredicted due to limited estimation of evapotranspiration in the forest area. Prediction of streamflow in 2001 was in very good agreement with observed data. Overall,

success of the SMR application to the larger watershed was remarkable since no calibration was performed. Methods also were developed to assist in watershed assessment and TMDL (Total Maximum Daily Load) development for sediment. These methods include the Revised Universal Soil Loss Equation (RUSLE) and associated sediment delivery ratio for sheet and rill erosion, and the Water Erosion Prediction Project (WEPP) model for erosion from roads. The RUSLE was applied in a GIS (Geographic Information System). The WEPP model was linked to a GPS/GIS integrated approach to obtain road attributes. While these methods appear promising for future use in basin-scale sediment budget analyses, more validation using field data is required. Research was conducted to understand ground water recharge in the region using chloride depth profiles. We measured pore-water chloride in loess deposits of the eastern Palouse region in northern Idaho, where multiple sequences of buried soils extend to ~20 m. Characterization of deep strata revealed complex sequences of extremely dense paleosol fragipans interstratified with less dense leached horizons. Abrupt changes in chloride concentration reflect boundaries between these stratigraphic units that display contrasting physical and pedogenic properties. Results illustrate that loess stratigraphy influences water movement in the Palouse, and that chloride depth profiles can be used as indicators of deep stratigraphy across various landscape positions.

Impact:
Scientists in regulatory agencies and Native American Tribes are in need of computer tools to assist in watershed assessment and the development of the TMDL. These scientists are under extreme time pressure to complete assessments for large basins and individual watersheds. We are developing these tools in a geographic information systems environment. These tools include a simple hydrologic model, which relies on publicly available data and does not require lengthy calibration, and methods to estimate erosion from agricultural fields and roads in forest and rural areas. Application of these tools to watersheds of the Northwest Wheat and Range Region can identify sensitive areas within river basins where watershed managers can achieve the best results for the least investment of money and time.

2. PLANT AND SOIL TEST CALIBRATION FOR IRRIGATED CROPS IN SOUTHERN IDAHO

Investigators: Brown, B. D.
Termination Date: 06/30/2002
Reporting period: 03/01/1998 to 06/30/2002

Termination Report:
All field studies related to irrigated winter wheat response to spring measured residual N were completed and the UI Fertilizer guide revised accordingly. Spring soil test N proved an effective means of predicting winter wheat N response, frequently more effective than fall measured N due to over winter changes in residual N due to mineralization or leaching. Onion N studies also were concluded and fertilizer guides for the state and region published. Fall N sources for onions have proved less effective than spring sidedressed N. High fall applied urea N rates greatly reduced onion stands and production.

Impact:
Improved fertilizer management for wheat, barley, and onions should result in reduced fertilization costs and reduced potential for groundwater contamination in southwestern Idaho.

3. WATER USE, GROWTH, NUTRITION, AND FRUIT QUALITY AS INFLUENCED BY IRRIGATION SYSTEMS IN 'FUJI' AND 'GALA' APPLES, AND BY ROOTSTOCK IN 'GALA'

Investigators: Fallahi, E.
Termination Date: 06/30/2007
Reporting period: 07/01/2002 to 12/31/2002

Progress Report:
Fruit quality and yield are affected by the quantity of water and rootstock. Also, water usage is becoming very important as the world's population increases, and many fruit producing areas are facing water shortages. This project will examine the effects of different irrigation regimes in 'Fuji' and effects of drip and sprinkler irrigation systems and five rootstocks in 'Gala' apple on fruit quality, yield, nutrition, and storability. The experimental orchard was established at the University of Idaho Pomology Orchard during Spring of 2002. Several drip and sprinkler irrigation systems, including, partial zone drying system were installed in this orchard and data will be gathered on tree growth, nutrition and fruit quality in the near future.

Impact:
This project will assist growers in using the least amounts of water while producing high quality 'Gala' and 'Fuji' apples.

4. INFLUENCE OF VOLCANIC ASH AND LOESS ON THE FORMATION, PROPERTIES, AND MANAGEMENT OF IDAHO SOILS

Investigators: McDaniel, P. A.
Termination Date: 06/30/2004
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
This project focuses on wind-blown silt and volcanic ash parent materials. We have completed a study looking at perched water tables in the Palouse region and the use of naturally occurring (Cl- and oxygen-18) tracers to help determine regional recharge rates. Our research has shown that pore water retention times derived from Cl- distributions indicate soil water in these soils is trapped and recharge rates are less than 0.29 cm/year. Oxygen-18 signatures further indicate that pore waters located several meters below the soil surface are relatively old, and perhaps date to glacial times. Through development of GIS, we have been able to estimate the aerial distribution these soils - almost 70% of the Palouse Basin has soils with low or moderate potential for recharge. This model represents the first comprehensive attempt to combine

existing geological and soil databases to extrapolate site-specific research data. We are continue to work with the Natural Resources Conservation Service (NRCS) and the US Forest Service to develop an Andisol database linking productivity to andic influences in forests of northern Idaho. Current studies have shown that up to 30% of applied sulfur is sorbed and rendered unavailable to plants in forested volcanic ash soils of the region. We have also initiated a project with the US Forest Service to examine the effect of management (harvesting, fertilization) decomposition rates in volcanic ash soils. This study is being conducted at seven sites across the region that have varying degrees of volcanic ash influence. Current work with the NRCS is examining the utility of using mean annual precipitation and landscape position to predict the degree of volcanic ash weathering in soils of the region. The degree of weathering controls the expression of properties that are unique to volcanic ash soils and that influence soil management. I continue to serve as the Idaho Agricultural Experiment Station representative the National Cooperative Soil Survey program.

Impact:
We have identified areas of the Palouse Basin that have soils in which little, if any, deep recharge occurs. This is a valuable database for planners and those attempting to better model regional groundwater supplies and recharge mechanisms. In forests of the Inland Pacific Northwest region, variable growth responses to sulfur fertilization have been observed. Our work suggests that enhanced sorption occurs in volcanic ash-influenced soils, and this has important implications for forest fertilization practices.

5. BIOCHEMISTRY OF SULFUR CYCLING IN THE SOIL ENVIRONMENT
Investigators: Morra, M. J.
Termination Date: 06/30/2004
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Soil is a primary component in the biogeochemical S cycle, mediating oxidation state changes and acting as a source and sink for various S species. Despite this importance, we know very little about S pools and transformations in soil. Our ability to provide adequate amounts of S for optimum plant growth and ensure environmental quality is severely limited by this lack of understanding. We are addressing agricultural and environmental aspects related to the soil S cycle is to 1) define the important S pools and 2) delineate the most significant transformations occurring among those pools. Current projects are focused on determining the fate and biological activity of S-containing allelochemicals and delineating diagenetic reactions of S minerals that influence the cycling of metal contaminants. Work with allelochemicals has centered on glucosinolates, S-containing compounds of interest in pest control strategies. Glucosinolates contained in members of the Brassicaceae release isothiocyanates potentially useful in controlling Fusarium oxysporum pathogens in conifer seedling nursery soils. Our objective was to determine the toxicity of individual isothiocyanates to different growth stages of the fungus. Bioassays with four F. oxysporum isolates were conducted using sealed containers in which 2-

propenyl, ethyl, buty, phenylethyl, benzyl, or phenyl isothiocyanate was allowed to volatilize. Propenyl and ethyl isothiocyanates were the most fungistatic of those compounds tested. The same concentrations of propenyl and ethyl isothiocyanates that inhibited mycelial growth completely suppressed conidial and chlamydospore germination of all isolates. Other isothiocyanates including ethyl, benzyl, and phenethyl were also fungitoxic to F. oxysporum conidia and chlamydospores. Reduction in pathogen populations resulting from a green-manure crop are likely achievable since chlamydospores are sensitive to isothiocyanate. Pathogenic F. oxysporum isolates infesting nursery soils would likely be most suppressed by species of plants such as Brassica carinata, B. nigra, and B. juncea, which contain glucosinolates that release high concentrations of propenyl isothiocyanate. Our research on S minerals has involved metal cycling in mining-contaminated lake in northern ID. To determine S species in the lake sediment pore waters we are using several approaches, including cyclic voltammetry and chromatography. However, these techniques are designed for analysis of the solution phase only. To speciate solid phase S we are using X-ray absorption near edge spectroscopy (XANES) on the sediments. XANES is ideally suited for determining oxidation state and in many cases can provide information about molecular speciation. Since the formation of S complexes and precipitates with the metal(loid) contaminants in the sediments is dependent on the oxidation state, the information obtained from XANES will be extremely valuable for this project. Preliminary investigations have shown that we can indeed identify S species in sediment cores from Lake CDA. Data indicate that diagenetic reactions are occurring and that pyrite formation is taking place in-situ.

Impact:
By better understanding the chemistry of sulfur cycling within the environment it will be possible to take advantage of natural pesticides to control plant pests such as fungi. Sulfur chemistry is also important in processes that control how toxic metals are transported in the environment and what can be done to prevent possible human health problems.

6. MICROIRRIGATION TECHNOLOGIES FOR PROTECTION OF NATURAL RESOURCES AND OPTIMUM PRODUCTION

Investigators: Neibling, W. H.
Termination Date: 09/30/2004
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
A 3-year late season irrigation management study on malting barley was completed this year. Details and results are given in a Ph.D. dissertation currently in final revision. Irrigation was stopped at four crop stages: milk, pre-soft dough, soft dough and post soft dough. Yield and quality were optimum when the crop root zone was filled to field capacity after last irrigation at soft dough. Water use efficiency was highest while yield and quality were nearly as high for the pre-soft dough treatment. Irrigation after the soft dough stage applied water that was not needed and reduced both yield and quality. A 3-year late-season irrigation management study on sugarbeets was initiated this year. Irrigation was stopped with the root zone at field capacity at 5 dates, ranging from July 20 to August 20. Crop yield and sugar content were highest for the August 20 treatment. Yield increased linearly from earliest to latest cutoff date. Previous work indicated that early irrigation cutoff resulted in higher sugar content, although that was not

observed this year. An irrigation water management study was initiated on potatoes in eastern Idaho. Potatoes from a number of fields were rejected by packers last year because of poor quality due to over-watering. Watermark soil moisture sensors and Hansen AM400 data loggers were installed in 30 fields of varying soil texture. Laminated cards with information relating watermark readings to stress level and water required to refill the root zone for four soil textural classes were developed and successfully used. Sensor information on current readings and trends for each of three soil depths was used to schedule irrigations. Comparison of appropriateness of water management and yield of fresh pack potatoes showed a strong correlation. The packer has ordered this equipment for all his fields for next year.

Impact:
The malting barley study showed that yield and quality could be improved by avoiding over-irrigation. Optimum irrigation cutoff can save at least one or two irrigations relative to current practice. This saves labor, water, and energy, resulting in higher net return per acre. The sugarbeet study will develop a relationship between the date of last irrigation and beet yield relative to maximum. This information is needed to evaluate the relative profitability of using limited water on various crops during the mid to late portion of the growing season. Last year, potatoes from a number of fields were not suitable for fresh pack use due to over watering. This greatly reduces income from the field. For example, revenue was reduced by about $200,000 on one 120-acre field last year because potatoes were rejected for fresh pack. This year, none of the fields using the moisture sensors and data loggers were rejected.

7. CHARACTERIZATION OF THE ACTIVITIES OF PLANT GROWTH PROMOTING STREPTOMYCES IN THE RHIZOSPHERE

Investigators: Crawford, D. L.
Termination Date: 06/30/2005
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Streptomyces are root-colonizing soil bacteria. Some rhizosphere colonizing species are plant growth promoting rhizobacteria (PGPR) that enhance plant growth and protect roots from phytopathogens, particularly fungi. We study the plant growth enhancing properties of these Streptomyces, focusing on the interactions of Streptomyces lydicus strain WYEC108 with pea and soybean. This strain enhances growth of peas in part by colonizing the root nodules. Our most recent work shows that S. lydicus enhances plant growth by colonizing the surface layers of the nodules and aiding the plant in assimilating iron into the nodules and then into bacteroids within them. The Streptomyces appear to make hydroxamate type siderophores which are involved in sequestering iron and in some as yet unknown way, transferring it to the bacteroids. This is a new phenomenon of plant growth enhancement not reported previously. Evidence also suggests that this type of plant growth enhancement occurs in nature, as evidenced by confirmed colonization of legume nodules by naturally occurring actinomycetes within randomly examined samples of peas taken from fields in the Pacific Northwest. In addition to siderophores, production of phytohormones, solubilization of phosphates or other minerals, and/or nitrogen fixation may be involved in plant growth promotion by these Streptomyces. Strain WYEC108 also produces an antifungal and several anti-Gram positive antibiotics when growing in the rhizosphere. The antifungal actability protects plants against invasion by fungal root pathogens.

Studies of the structures, biosynthetic pathways and genetic regulation of these antibiotics are ongoing. We continue to also study other rhizosphere-colonizing actinomycetes. All are Streptomyces strains. In particular, we are characterizing strains isolated from the roots of desert shrubs such as sagebrush (Artemesia tridentata and related species). These Streptomyces are producers of a range of antifungal antibiotics, some of which appear to be novel. Since there is a significant need for new antifungal antibiotics for use in human and veterinary medicine, we are pursuing the purification and identification of these novel compounds. These antibiotics are effective against phytopathogenic fungi as well as animal and human fungal pathogens such as yeasts (Candida albicans). Some of our stains also promote plant growth (e.g., vegetables, legumes) in the absence of pathogens, and growth promotion is not related to their antibiotic producing abilities. Our goal is develop selected of the strains as biocontrol agents, PGPR, and as producers of novel antibiotics. Finally, in studies with sagebrush root exudates, we have shown recently that the production of antibiotics by rhizosphere isolates of Streptomyces is induced by soluble metabolites present within the rhizosphere. Certain Streptomyces do not produce antibiotics in laboratory medium unless root exudates are added as elicitors/inducers. In other strains, elicitors enhance antibiotic production. The significance of this previously unobserved phenomenon is under investigation.

Impact:
The focus of our research is on the interactions between rhizosphere colonizing Streptomyces and their plant hosts, and on developing these microbes into useful products for improving crop yields. Another objective is to isolate and develop new antifungal antibiotics for veterinary and pharmaceutical use. One commercial product employing S. lydicus WYEC108 for promotion of plant growth is already commercially available.

8. AGRICULTURAL WATER MANAGEMENT TECHNOLOGIES, INSTITUTIONS AND POLICIES AFFECTING ECONOMIC VIABILITY AND ENVIRONMENTAL QUALITY

Investigators: Walker, D. J.
Termination Date: 06/30/2005
Reporting period: 07/01/2000 to 06/30/2005

Termination Report:
Dr. Walker has retired from the University of Idaho and this project has terminated. We have completed a spreadsheet based computer model called Dairy Manure System Planner. This is a decision aid for dairy managers to design and evaluate alternative dairy waste management systems. The model calculates the annualized cost of constructing, operating and maintaining the systems. The program uses a combination of user specified data as well as pre-defined data tables containing various dairy system options. The protocol for life cycle costing of the systems was established using annual equivalent value in a real (versus nominal) analysis. The model tracks nutrient flows, including nitrogen, phosphorous and potassium from animal feeds through the manure handling and storage system and onto field application as fertilizer. A fertilization module contains climate data to calculate the rate of nitrogen volatilization during manure handling and storage. This will provide the basis for determining the nutrient value of the dairy waste applied to crops and pasture. Work has begun on a linear programming model to optimize in choosing among alternative systems. Choice variables available for optimizing include manure

collection system, storage system, solid separation and field application. Feed ration is also a choice variable. The model will maximize net revenue subject to environmental constraints.

Impact:
The decision support system will provide a useful tool for economically efficient nutrient management for a sustainable dairy industry

9. ALGORITHUM DEVELOPMENT FOR REMOTE SENSING OF IDAHO WATER RESOURCES AND FIELD BURNING

Investigators: Qualls, R.
Termination Date: 06/30/2005
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
During the reporting period, a second field experiment was conducted, and the computer code for a mathematical model to simulate radiative transfer processes within a plant canopy was developed and generated. This year's experiment was conducted in a winter wheat field from May through August. The measurements included a set of infrared canopy temperature profile measurements, leaf area index (LAI), and incoming and outgoing long- and short-wave radiation components, eddy correlation momentum, heat and water vapor fluxes, wind speed, air temperature, humidity, and soil moisture, temperature and heat flux. While analyzing the 2001 field experiment data, we found that the interval over which we measured a single canopy temperature profile was too long, with the result that temporal changes in the profile obscured the spatial changes in the profile. Consequently, we redesigned our transport device to collect profiles more rapidly. The radiation model accounts for multiple reflections of radiation in multiple layers within the canopy. Our analysis from the 2001 data set showed us that we needed detailed within-canopy radiation measurements in order to validate our radiation model. We added these measurements during the 2002 field experiment. We have completed the computer code to carry out the computations, and run numerous simulations. We have compared these simulations with radiation data measured within the canopy with good results. Previously we had assumed that only vertical temperature variation existed with the wheat canopy. However, based on field observations, we believe that the row structure of the canopy may induce significant horizontal variability as well. A model study of horizontal and vertical temperature variability of plant canopies was conducted. Results showed that under some circumstances, the row structure of the plants must be accounted for explicitly. The next phase of the research will be to complete and test the convective transport model and couple it with the radiation transport model. Model output will include heat and moisture (evapotranspiration) fluxes and temperature profiles of the canopy. These data will allow us to validate the model fluxes and temperature profiles. One of the important scientific outcomes of this research will be to determine the characteristic behavior of the canopy temperature profiles and how radiation interacts with vegetation structure and density to generate these profiles.

Impact:
This project will enable modifications to be made to numerical weather models, such as those used to generate the 10-day weather forecast, which will improve their accuracy. Furthermore, it will allow the models to begin incorporating remote sensing data such as satellite surface

temperature measurements. This latter accomplishment will produce models with much finer spatial resolution, thereby improving the weather forecast for individual small communities.

10. RATES AND MECHANISMS OF CHEMICAL REACTIONS IN SOILS
Investigators: Strawn, D. G.
Termination Date: 06/30/2006
Reporting period: 01/01/2002 to 12/31/2002

Progress Report**:**
Investigation of reaction mechanisms of chemicals in the soil environment were contintued. This entailed primarily two studies: Copper sorption mechanism on clay minerals, and phosphorus desorption kinetics and speciation in manure-amended soils. In the Cu-clay study we found that Cu forms up to three different kinds of complexes on the clay mineral surface, depending on equilibrium conditions and clay mineral properties. For example, it was discovered that vermiculite forms an extensive multi-nuclear complex while montmorillonite forms only a small dimmer-like complex under the same equilibrium conditions. The third type of sorption complex of Cu on clay minerals that has been identified is an outer-sphere complex. For the P desorption experiments we found that the release for P from manure-amended alkaline soils is a slow process that exceeds the average residence time of irrigation water in the soil profile. This implies that kinetic models are more appropriate for modeling P availability for leaching into surface waters than equilibrium models. In addition our results suggest that although the P is present in the soils as both organic and inorganic phases, the only phase available for desorption is inorganic.

Impact:
In order to protect the environment from contamination from heavy metals (e.g. copper) or over-applied nutrients (e.g. phosphorus and nitrogen), it is imperative that reaction processes be included in management and environmental fate modeling. The soil is an important medium in chemical reactions in the environment. Results are providing reaction process data for heavy metals and phosphorus, and will help explain the observed behavior of the chemicals in the environment, as well as help develop effective remediation and management strategies.

11. MANAGEMENT AND MANIPULATION OF THE C CYCLE TO INCREASE YIELDS AND SOIL QUALITY IN NO-TILL SYSTEMS
Investigators: Johnson-Maynard, J. L.
Termination Date: 06/30/2007
Reporting period: 07/01/2002 to 12/31/2002

Progress Report:
Although this project is only six months old, significant progress has been made on setting up field experiments, sampling soils and residue, and generating preliminary data. The first aspect of this project relates to carbon accumulation in no-till (NT) agricultural systems. Multiple on-farm sites developed during the spring of 2002 will be used to extend the data gathered at the University of Idaho experimental farm in Genesee, ID. The experiment consists of replicated conventional till (CT) and NT plots along a typical Palouse hillslope. The on-farm portion of this

work includes a total of 12 fields (three CT wheat; three CT peas; three NT wheat; and three NT peas). Two transects were created in each field for a total of 24, 1000 ft long transects. Soils and macrofauna were sampled at the end and central points of each transect during the summer of 2002. Currently soil samples are being analyzed in the laboratory for total C and N as well as inorganic (plant available) N. Earthworms collected in each plot were counted and weighed. Each site has been surveyed and mapped using a combination of laser theodolite, GPS, and GIS. Detailed soil samples were taken at the University farm and are currently being analyzed for total C, N, inorganic N, pH, and physical properties. Macrofauna were collected in both early spring and summer. The second portion of this project deals with gaining a better understanding of the decomposition process in Kentucky bluegrass seed production systems. These data will be used to develop sustainable, non-thermal residue management techniques. With the help of other UI Kentucky bluegrass researchers, replicated plots were developed in both Lewis and Kootenai Counties. Replicate soil samples were taken from three depths within each plot at each site to characterize the soil physical and chemical properties before treatments were applied. Treatments at the Kootenai Co. site include full-load burn; bale and burn; bale/mow/harrow; and bale/mow/harrow yr 1, bale/burn yr 2, full-load burn yr 3 with the same sequence of treatments repeated in years 4, 5, and 6. At the center of the Lewis Co. study is a new production system developed by a grower cooperators involved with this project. In this system, instead of burning, the field is chemically fallowed, mowed, and harrowed to increase decomposition of the residues over the fallow year. Residue levels were monitored over the spring and summer of 2002 to determine the impact of management on decomposition rates. Preliminary data indicate that residue at the Lewis Co. site has a lower C:N ratio than the variety grown at the Kootenai Co. site and, therefore, should decompose faster. Residue levels at the Lewis Co. site decreased faster and to lower levels then they did in the bailed plots at Kootenai Co. These data suggest that 1) the ability to encourage decomposition and therefore create sustainable non-thermal residue management practices, will depend on variety and/or site-specific environmental conditions, and 2) the process of bailing may not be necessary in all non-thermal Kentucky bluegrass seed production systems.

Impact:
The expected impacts of this project include, 1) the development and implementation of improved nutrient and residue management in no-till systems, 2) development of data sets which will help Idaho growers participate in C credit trading systems, 3) the maintenance or increase in non-thermally managed Kentucky bluegrass acreage which will lead to improved soil, water, and air quality, and 4) avoided court cases and economic loss for Idaho Kentucky bluegrass seed producers.

12. CHARACTERIZATION OF FLOW AND TRANSPORT PROCESSES IN SOILS AT DIFFERENT SCALES

Investigators: Tuller, M.
Termination Date: 09/30/2004
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
We made significant progress during the reporting period towards a comprehensive framework for modeling hydraulic behavior of clay soils. After development of a geometrical pore space

evolution model that considers a hierarchy of pore spaces in the clay matrix and between other textural components (e.g., sand or silt grains) and is linked to soil hydration state we introduced hydrostatic and hydrodynamic considerations to model liquid retention and swelling behavior and to predict saturated hydraulic conductivity of clay soils at the pore and sample scales. Preliminary calculations and comparison with measured data show the great potential of the proposed approach. To further refine the model and to evaluate effects of clay type, clay content, solution chemistry and solution concentration on swelling behavior and hydraulic properties we recently started a series of laboratory experiments using a state of the art, fully automated flexible wall permeameter. Preliminary measurements and comparison with model calculations are very promising. Currently we are working on statistical upscaling schemes to predict swelling behavior and hydraulic conductivity at the sample and profile scales. Collaboration with the Geotechnical Engineering group at Washington State University allows us access to a latest technology Computed Tomography (CT) System that we apply to resolve and introduce anisotropic behavior due to directional orientation of clay platelets. Some of the physically based phenomena investigated for swelling soils were also applied to predict hydraulic functions for structured soils and fractured rocks. Pore scale liquid behavior calculated from thermodynamic principles also builds the bases for a model we developed during the reporting period to support the design of artificial plant growth media for advanced life support systems in space. Previous plant growth experiments during space flight revealed difficulties with water, nutrient, and air supply to plant roots. These limitations were attributed to design flaws due to limited understanding of liquid behavior and configuration in particulate porous media under reduced gravity. Microgravity could affect pore-scale liquid organization by enhancing phase entrapment and changing interfacial configurations. As a first step we were able to solve the Augmented Young-Laplace AYL without gravity term to predict liquid behavior under reduced gravity. These insights will be used in combination with KC-135 flight experiments to design root modules and growth chambers suitable to support plant growth in space. This project is supported by NASA.

Impact:
The project on swelling soils will significantly contribute to improved predictions of water flow and solute interactions in agricultural soils with appreciable amount of clay minerals, and lead to improved salinity and sodicity management practices in irrigated agricultural areas. Furthermore, insights gained from this study will enhance understanding of clay dispersion and surface sealing, and lead to improved management guidelines for prevention of soil erosion, and associated colloid facilitated transport of agrochemicals. In extreme cases, improved ability for prediction of the onset of surface runoff from clay soils at the field and watershed scale can prevent catastrophic events, such as flooding and could provide early warning and save lives and property. Besides agricultural and environmental applications the project also provides new insights for geotechnical engineering. Structural damage to buildings and roads due to active clay soils is an important economic factor. Improved predictions of swelling behavior could prevent such damages and save millions of dollars every year. Another potential application is the development of design criteria for clay liners used to seal waste repositories to prevent leaching and migration of toxic contaminants to aquifers and other water resources. Our investigations and modeling efforts regarding liquid behavior in plant growth substrates under reduced gravity should significantly contribute to the design of root modules for plant growth and advanced life support systems in space.

13. PHOSPHORUS, ZINC, IRON, MANGANESE, AND COPPER INTERACTIONS IN EAST-IDAHO POTATO CROPPING SYSTEMS

Investigators: Hopkins, B. G.
Termination Date: 06/30/2007
Reporting period: 07/01/2002 to 12/31/2002

Progress Report:
The first year of a phosphorus-zinc fertilizer interaction study was completed at a UI Aberdeen Research & Extension Station field with 15 ppm bicarb P, 5% excess lime, and 1.0 ppm DTPA Zn. The study consisted of five replications in a RCBD experimental design of all combinations of the following treatments: 0, 200, 400, 600 lbs-P2O5/acre and 0 and 20 lbs-Zn/acre. Significant responses were observed both for phosphorus and zinc fertilization, as well as a significant interaction between the two. Applying phosphorus at the recommended rate of 200 lbs-P2O5/acre resulted in a significant yield increase; however, excessive application [2 times the recommended rate (2x) or 3 times (3x)] decreased yields relative to the recommended rate. Applying zinc alleviated the negative effect of excess phosphorus, although only at the two highest high rates of phosphorus. Tuber quality differences were statistically significant in this study. It is apparent from these results that excess phosphorus does result in reduced potato yields and that zinc can correct the problem. More work is needed to elucidate proper rates and/or ratios of phosphorus and zinc for optimal potato production.

Impact:
The expected impact of this study is to determine if added micronutrient fertilizers ameliorate the effect of high rates of phosphorus fertilizer applied to potatoes and subsequent rotational crops (wheat and maize). If so, determine the appropriate rates and/or ratios of micronutrient fertilizers that need to be applied in combination with phosphorus to avoid yield and crop quality decline in areas of a field receiving more phosphorus than is optimal.

14. PEROXIDASE-SUBSTRATE INTERACTIONS AS A MODEL FOR DESIGN OF BIODEGRADABLE COMPOUNDS

Investigators: Crawford, R. L.
Termination Date: 06/30/2003
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
This project has involved studies aimed at understanding the influences of organic chemical structure on biodegradability of anthropogenic chemicals. The model system chosen employed the fungus Phanerochete chrysosporium and the chemical group known as azo dyes. P. chrysosporium is well understood as regards it use of peroxidases to degrade both natural and xenobiotic organic compounds. The azo dyes are within a class of chemicals that are a significant source of environmental pollution (e.g., the textile and printing industries). Azo dyes also represent a class of chemicals where it is possible to introduce hundreds of subtle structural variations to examine their effects on the primary structure's biodegradability. Our work has

shown that azo structures that have some resemblance to the natural structure of plant lignins (e.g., the presence of aromatic methyl and methoxyl groups) in specific ring locations are more biodegradable than structures that lack these properties.

Impact:
This work provides information that will allow industry to synthesize new types of azo dyes that are inherently biodegrdable. This will, in turn, improve the quality of life of United States citizens by protecting the environment from pollution by this class of industrial chemicals. Since 1998 this project has supported the training of 3 graduate students and 2 postdoctoral scientists, adding to the nation's pool of scientists trained in environmental science.

15. GENETIC AND BIOCHEMICAL ANALYSIS OF ZINC TOLERANCE IN ARABIDOPSIS AND RICE

Investigators: Caplan, A. B.
Termination Date: 06/30/2003
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
The goal of this research is to enhance the tolerance of plants to toxic metals such as zinc in order to improve their performance as bioremediative agents. In the pursuit of this goal we are attempting to augment the tolerance of rice and tobacco by overproducing two rice genes that are strongly induced by metal treatments. Secondly, we are attempting to develop metal-chelating proteins targeted to different organelles to trap metals as they come into the cell. Over the last year, we have generated approximately 20 lines of tobacco overexpressing either the rice gene salT or the rice gene rezA. Preliminary experiments were done to determine whether one or either of the rice genes affected tolerance levels of the heterologous host. These studies indicated that some of these lines displayed enhanced root and shoot growth when vegetative cuttings were planted on sterile media containing sublethal doses of either NaCl or ZnCl2. We are currently germinating the F1 generation from the inbred lines in order to perform phenotypic tests on the plants and to continue inbreeding for homozygosity. We have also generated and begun inbreeding a number of rice lines transformed with the same constructs. Basic Southern and northern analysis is underway, prior to phenotypic testing of representative transformants. We have continued working on the isolation of artificial zinc-binding proteins generated in vitro, and screened by expression in yeast. Each of these constructions adds one or more motifs to a protein "backbone" encoding an ER-targeting sequence and the beginning of a P450 gene isolated from Arabidopsis. Fusions of this sequence to GFP have shown that the plant targeting sequence is localized correctly in yeast. We have preliminary evidence showing that adding long, randomly-generated peptides to the C-terminal end of this small peptide inhibits yeast growth slightly. Since this effect is not dependent on the concentration of zinc in the medium, it seems likely that the inhibition either results from clogging of the ER- import machinery, or from the kinds of deleterious effects associated with misfolded proteins. One of the consequences of this phenomenon has been that when we screen for proteins with multiple insertions of zinc-binding motifs, they tend to be the slower growing colonies and not the faster ones on zinc containing media. We are currently characterizing a number of the clones isolated in this way to improve our understanding of the effects of protein structures on yeast growth.

These studies will help us establish better parameters for constructing novel proteins.

Impact:
The development of novel metal chelating plant proteins will be important in several ways. By expressing these proteins in the leaves, we will create a sink for zinc that will ensure that much of the metal entering plants accumulates in the organs most easily harvested and removed from the site. Development of new phytoremediation agents could not only help to restore land for normal uses, but also offer a way to "mine" low grade ores for valuable metals. Second, by expressing these proteins in edible parts of the plant, we could enhance the nutritional value of crops grown in normal soils.

16. QUANTIFICATION METHODS FOR WATER RESOURCES MANAGEMENT AND PLANNING

Investigators: Allen, R. G.
Termination Date: 06/30/2004
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Evapotranspiration (ET) maps have been created for the entire portion of southern Idaho during 2002. The maps are based on year 2000 Landsat imagery and cover the period from March through October, which is the full growing season. The ET maps were created using the satellite-based SEBAL algorithm (Surface Energy Balance Algorithms for Land). Maps have a 30 m x 30 m grid size. SEBAL was also applied to Landsat images during the late 1980's and early 1990's and compared with precision weighing lysimeter measurements of ET. Results were very good. SEBAL has been evaluated during the past year to demonstrate that atmospheric correction of both short and long-wave radiation is not essential to obtaining accurate results. Sensitivity analyses have shown the relatively broad range of estimates of aerodynamic roughness and leaf area indices that can be tolerated during the ET prediction process. Other extensions have included applications in mountainous terrain where corrections for slope and aspect impacts on the total energy balance were refined. The Idaho Department of Water Resources (IDWR) has used the year 2000 maps as well as two ET maps for year 2002 to identify ground-water pumpers who are out of compliance with stated ground-water pumping permits. The ET maps have also been used as input for predicting recharge to the Eastern Snake Plain ground-water aquifer that is of substantial importance to the economy of southern Idaho. The ET maps show variation in ET within and among individual fields caused by crop type, farming practices, water availability, and irrigation management and uniformity. IDWR is also using ET maps created for the Boise River valley to assess the change in total water consumption (i.e., ET) when irrigated farmland is converted into residential land use. Water quality samples were collected during 2002 from points along the Snake River of central southern Idaho and from return flow channels entering the Snake from surface-irrigated tracts. Analyses include forms of nitrogen and phosphorus as well as sediment, pH, oxygen and temperature. Results are archived at http://www.kimberly.uidaho.edu/midsnake/ Results show trends in water quality of the Snake River within and among years. Crop coefficients by Dr. J.L. Wright of the USDA-ARS at Kimberly have been converted for use with the recently developed ASCE standardized Penman-Monteith reference evapotranspiration method.

Impact:
Improvements in predicting evapotranspiration improve how we manage water resources and produce food. Better irrigation management reduces impacts on water quality and quantity of river discharge. Monitoring of the Snake River has provided a baseline for comparing changes in water management practices over time. Verification and refinement of SEBAL provides the means for predicting evapotranspiration with high resolution for large land areas.

17. ASSESSMENT AND DEVELOPMENT OF METHODOLOGIES TO RAPIDLY ASSESS BMPS TO REDUCE SEDIMENT AND NUTRIENT RUNOFF FROM AGRICULTURE IN IDAHO

Investigators: Mahler, R. L.
Termination Date: 06/30/2005
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
In 2002 the primary focus of this project was to develop a N source assessment for agricultural soils of Twin Falls county, Idaho. The objectives of this study were to: (1) estimate the amount of inorganic N remaining in the soil profile after harvest for each of ten major crops (alfalfa, oats, sugarbeets, potatoes, winter wheat, barley, dry beans, grain corn, spring wheat, silage corn) grown in Twin Falls county, and (2) estimate the amount of inorganic soil N remaining as a result of the five most common crop rotation patterns used in the county and identify the potential impact of each rotation scheme on water quality. From a crop standpoint, silage corn production resulted in the lowest estimated residual inorganic N value of -253 lb/ac/yr. Nearly twice as much N was removed with each silage corn harvest (492 lb/ac/yr) than was removed as a result of alfalfa production (252 lb/ac/yr), which had the second largest N removal rate. Production of grain corn and oats resulted in the two highest estimated residual inorganic N values (198 lb/ac/yr and 180 lb/ac/yr) of all the major crops grown in Twin Falls county. These estimates were considerably higher than the inorganic N values calculated for the other eight major crops. The dairy crop rotation pattern (winter wheat, silage corn, alfalfa) resulted in the lowest estimated average residual inorganic N value (-26 lb/ac/yr) of the five crop rotations common to Twin Falls County and was the only rotation that appeared to be mining inorganic N from the soil. The primary reason that the dairy crop rotation scheme had the lowest estimated average residual inorganic N value is that this was the only rotation that included the production of silage corn. The sugarbeet crop rotation pattern (grain corn, dry beans, sugarbeets) had the greatest chance of creating conditions that would lead to increased nitrate-nitrogen levels in groundwater as a result of inorganic N leaching downward through the soil profile. Only the sugarbeet crop rotation scheme was comprised of crops that all had estimated residual inorganic N values greater than 100 lb/ac/yr. The estimates calculated in this study can be used to help determine the amount of inorganic N fertilizer leaching to ground water from cultivated soils in Twin Falls County. The results of this research should be used in combination with estimated of net N inputs from the other four major sources to assess their individual and collective impacts on ground water nitrate-nitrogen levels.

Impact:
Idaho farmers will be able to apply adequate levels of nutrients to their crops while protecting the quality of surface and ground waters of the state.

18. APPLICATION OF COUPLED ABIOTIC/BIOTIC PROCESSES FOR THE REMEDIATION OF CONTAMINATED SOILS

Investigators: Hess, T.
Termination Date: 06/30/2005
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Work related to the previously NSF-funded project "Coupled Chemical/Biological Oxidation of Nitroaromatic Wastes" was continued. The project sought to define optimum reaction conditions in aqueous solution for combining Fenton and biological reactions used for degrading 2,4,6-trinitrotoluene (TNT). The present work extends the combined Fenton and microbial reaction optimization procedures to soil solution. Previous preliminary work in soil solution had shown that due to the lack of homogeneity in the soil, the optimum reaction conditions were hard to define and repeat. Current work has better defined reaction optimization for use in kinetic studies. Work with degradation of hazardous compounds has also led to research in areas using molecular biological techniques. An externally funded project (Army Research Office), "In Situ Genetic Modification Of Natural Microbial Communities with Genes of Value for Bioremediation " has been under way since March 2000 to examine natural transformation of bacteria for use in degradation of trichloroethylene (TCE) and carbon tetrachloride (CT). Preliminary results in bench-scale in the laboratory have shown that model DNA constructs (containing antibiotic resistance genes) can indeed transform bacteria with resultant expression of function. Current work has focused on the use of genetic algorithms to optimize environmental conditions for promotion of gene transfer. An additional NSF funded molecular biological-based project "Life at Interfaces and Biocomplexity of Extreme Environments" was started in February 2002 with the objective of determining the molecular basis of energy flux in biofilms in thermophilic environments. Information developed from this project should be useful for examination of biofilms as they exist in nature and how they use energy inputs from biogeochemical sources.

Impact:
The work is expected to lead to cost-effective methods for remediation of contaminated soils beyond those currently available. Investigation of molecular mechanisms of contaminant use, energy flux and gene transfer, using current molecular biological techniques, is expected to add to the development of such remediation technologies.

19. CHEMICAL PROPERTIES AND BIOLOGICAL FUNCTIONS OF PYRIDINE-2, 6-DITHIOCARBOXYLIC ACID (PDTC), A METAL CHELATOR PRODUCED BY PSEUDOMONAS SPP.

Investigators: Paszczynski, A. J.
Termination Date: 06/30/2006
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Pyridine-2,6-bis(thiocarboxylic acid), also known as pyridine-2,6-dithiocarboxylic acid (pdtc), is a unique and powerful metal chelator produced by Pseudomonas stutzeri and Pseudomonas putida. The actual physiological roles of pdtc in these pseudomonads are not known with certainty, though it is likely that the compound acts as a siderophore, an antibiotic, or both. The stability constant of Fe(III):(pdtc)2 was determined in previous work to be 10 E33.36 (see published paper). Here we determined that the stability constant of Fe(II):(pdtc)2 is 10 E12. We determined this stability constant through potentiometric and spectrophotometric measurements of a ligand-ligand competition study using 2,6-pyridine dicarboxylic acid as the competitor for iron. A comparison of the stability constant for Fe(II):(pdtc)2 to the constant for Fe(III):(pdtc)2 - shows that the stability constant of Fe(II):(pdtc)2 is approximately 21 orders of magnitude smaller. This represents a very significant decrease in the binding strength of pdtc to Fe(II). Thus, if the host cell produces pdtc as a siderophore for sequestering Fe(III), it is likely that a second metabolite or a membrane protein of the host cell is used for reduction of the chelated iron at or near the cell membrane in order to facilitate its release from pdtc for cellular use.

Impact:
Determination of binding constants of the microbial metabolite pdtc (pyridine-2,6-bis[thiocarboxylic acid]) and certain metal ions can potentially be used to better understand this compound's behavior in subsurface environments contaminated with chlorinated solvents. The pdtc:Cu(II) complex catalytically degrades carbon tetrachloride (CT); this property of pdtc holds great promise for contributing significantly to solutions for certain CT contamination problems.

20. MICROBIAL ECOLOGY APPLICATIONS FOR PEST MANAGEMENT AND ENVIRONMENTAL PROTECTION

Investigators: Knudsen, G. R.
Termination Date: 06/30/2006
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Experiments continued to evaluate combinations of a microbial biological control agent and glucosinolate-producing amendments for disease control in production conifer nurseries. The Palouse River watershed in the vicinity of Laird Park, Idaho, was monitored monthly at several sites for presence and quantity of fecal coliform and other bacteria. Samples of E. coli bacteria from water samples are being compared with a database of E. coli ribotypes obtained from fecal samples from several animal sources, including human, bovine, avian, and equine. Similar sampling was done at two alpine lakes in the Seven Devils Wilderness area of Idaho. Results will be used to track and predict sources of fecal coliform pollution of these waters.

Impact:
Plant disease control using microbial agents will help reduce chemical pesticide usage and associated detrimental environmental impacts. Tracking sources of bacterial pollution in natural

watersheds will provide a management tool to help minimize health and environmental risks from E. coli and other bacteria in recreational waters.

21. RELATIONSHIPS BETWEEN GEOCHEMICAL REACTIVITY AND WATER CONTENT IN HETEROGENEOUS VADOSE ZONE GEOMEDIA

Investigators: Smith, R. W.
Termination Date: 06/30/2007
Reporting period: 07/01/2002 to 12/31/2002

Progress Report:
This research is a collaborative effort between the University of Idaho and the Idaho National Engineering and Environmental Laboratory (INEEL) with the goal of developing a better understanding of the relationships between reactivity and water content for vadose zone geomedia. The research goal is being accomplished through the use of unsaturated one- and two-dimensional reactive tracer experiments conducted in the environmental geocentrifuge facility at the INEEL. The INEEL centrifuge capabilities include an Unsaturated Flow Apparatus (UFA, model J6-UFA Beckman Coulter, Inc.) and a two-meter radius geocentrifuge (model C61-3 Actidyn Systems). Several key accomplishments in preparation for multi-dimensional transport experiments characterized the performance period (July 1, 2002 to December 31, 2002) of this new project. Chief among these was the commissioning of the C61-3 Actidyn two-meter centrifuge in September. Engineering studies are currently underway to develop "high-gravity" flow cells, fraction collectors, and instrumentation for the reactive transport experiments. The first reactive transport experiments in the C61-3 are expected to be conducted in the spring of 2003. With the INEEL collaborators appropriate methodologies to measure solute breakthrough concentrations (i.e. the electrical conductivity) in real time in the smaller UFA centrifuge were developed. In addition, existing quantitative numerical tools were modified to examine flow and transport in centrifuge experiments. Finally, an evaluation of batch experimental studies of strontium and uranium[VI] on to geomedia with natural coatings of hydrous iron and aluminum oxides was conducted. This study demonstrated that strontium adsorption is an effective probe for assessing reactive surface area of geomedia. The study also demonstrated that surface areas derived using the strontium probe can successfully predict the interactions of chemical species that exhibit complex sorption behavior such as uranium[VI]. These findings provide a reactive surface area probe that will be used in unsaturated centrifuge experiments. Investigations focused on fluoride sorption will assess its effectiveness as a probe of reactive hydrous aluminum oxides and poorly crystalline aluminosilicates in geomedia.

Impact:
The coupled biogeochemical and hydrological processes that influence the migration of contaminants and other chemicals through the vadose zone are poorly understood. This project improves the understanding of transport and transformation of chemicals in the vadose zone by assessing the effects of changing water content on sorption and transport processes. With this improved understanding agricultural, industrial, mining, and energy operations and waste disposal activities can be better managed to provide enhanced protections of groundwater resources.

22. CONVENTIONAL AND ECOLOGICALLY BASED CONTROL PRACTICES FOR POTATO INSECTS AND PLRV TRANSMISSION

Investigators: Alvarez, J. M.
Termination Date: 06/30/2007
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Implementing biological control as part of an IPM program in Idaho: In efforts to identify and investigate potential biological control agents in potato fields, an inventory of natural enemies occurring in southeastern Idaho was conducted. Coleopterans dominated the complex of ground arthropods and Pterostichus melanarius (Pm), an introduced European carabid species,

biological control agents of potato pests. This research will identify effective natural enemies in Idaho that could be compatible with new selective pesticides. Less insecticides usage would reduce pest control costs and consequently a higher income for growers and reduced health risks for all people involved in crop management. Saving even one pesticide application per year would result in a substantial savings to growers and would greatly reduce the use of organophosphates. Our program will utilize grower-cooperators as the primary outreach component, complemented with a web site and traditional extension outreach programs such as the Potato Schools and commodity publications. For virus management, even the most intense aphid control may not prevent spread of PLRV unless measures are also taken to keep virus-source plants at a minimum. We are currently caution growers to keep their nightshade well in check, especially in seed-growing areas where disease prevention is essential.

23. REWETTING TRANSITION EFFECT ON COLLOID TRANSPORT AND

Total	**9.76**	**4.0**	**$2,868,783**

IAES Program 8: Pollution control and natural resources (RPA 605). IAES Program 8 also contributes to **REE Goal 4** and includes 2 research projects and approximately 0.6 SY of faculty research effort.

Performance Goals:
One of the primary projects in this program deals with the economic costs of soil erosion and methods to reduce erosion. Both income effects and health concerns are addressed. A second major goal is to provide a safe environment for the public.

Progress/Impacts:

1. THE ECONOMICS OF RANGELAND MANAGEMENT, IMPROVEMENTS AND CHANGES IN LAND USE POLICIES
Investigators: Rimbey, N. R.
Termination Date: 06/30/2004
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Another cooperative research project was initiated with the Bureau of Land Management to update economic models for Owyhee County, Idaho; survey users of the Birds of Prey Area; update social assessments of Owyhee County; and develop a regional input-output model for the 4-county area in SW Idaho. Economic models developed through multistate project W-192 have been used to assess ranch level economic impacts of land management policy changes. Support for the Policy Analysis Center for Western Public Lands continued through 2002, resulting in the completion of projects dealing with Pinon-Juniper woodlands and sage grouse.

Impact:
The project describes resource management policy alternatives for public lands in SW Idaho that employ current social and economic information. Information generated will be useful to a multitude of federal and state agencies, along with local governmental units.

2. RURAL COMMUNITIES AND PUBLIC LANDS IN THE WEST: IMPACTS AND ALTERNATIVES
Investigators: VanTassell, L. V., Rimbey, N., Wulfhorst, J.
Termination Date: 09/30/2006
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Stochastic beef cattle price simulation models were developed for Idaho, Wyoming, New Mexico, Utah, Nevada and Oregon. The structural part of the models incorporated a seasonal (monthly) and long-term (12-year) price cycle. Multiple period autoregression was found in the estimated equations and was incorporated in the models using a recursive process when

correlating the random deviates used in the stochastic simulation. For each state, monthly prices for steers, heifers, culls, and replacements were estimated for a 50-year planning horizon for 1,000 iterations. Prices were incorporated into multi-period linear programming models for each state to examine ranch level impacts from potential federal grazing policies.

Impact:
Methodology was developed to incorporate the price risk public land livestock producers face in their livestock business. This will provide public land ranchers information for use in their decision-making process when confronted with grazing policies affecting federal lands.

Allocated Resources IAES Program 8:

RPA	SY	PY/TY	Amount
605	**.59**	**0**	**$193,691**
Total	**.59**	**0**	**$193,691**

GOAL 5: Enhanced Economic Opportunity and Quality of Life For Americans

IAES Program 9: Economic Enhancement, Improved Quality of Life (RPAs 608, 801, 802, 803). IAES Program 9 contributes to **REE GOAL 5**. This program area includes 4 IAES research projects and accounts for approximately 5.8 SY of faculty research effort.

Performance Goals:
1. To improve the social and economic well-being of rural communities in Idaho by providing data and information on local demographics, interactions between components of the community, and planning for economic growth of the geographic unit
2. Determine how work factors (e.g. time, support, and control) enhance or impede family performance and well-being
3. Explain the consequences of family/work interaction for family members and workplace
4. Increase understanding of parents' feeding of infants and young children and the development characteristics of eating skills for young children
5. Increase understanding of culture and the mealtime environmental factors that facilitate development of self-feeding skills.

Progress/Impacts:

1. RURAL ECONOMIC DEVELOPMENT: ALTERNATIVES IN THE NEW COMPETI TIVE ENVIRONMENT
Investigators: Cooke, S. C.
Termination Date: 09/30/2002
Reporting period: 10/01/1997 to 09/30/2002

Termination Report:
A Computable General Equilibrium Analysis of a Property Tax Reform in the State of Idaho contributes to the general equilibrium literature as it applies to regional economics. This research provides an accuracy and coherence way to hypothesize the effects of a policy shock on the tradable and non-tradable sectors of a regional economy. The tradable and non-tradable distinction is important conceptually both to understand a regions economic behavior and to model the effects of a change in policy correctly. The proposed property tax reduction in Idaho was analyzed using this approach. The results provide testable hypotheses on the likely impact on this state's tradable and non-tradable sectors and the associated income distributive effects from a tax reduction. By contrast, other economists divide the economy into goods and services. The goods/services distinction is convenient but conceptually incorrect. These categories are approximations of the theoretically correct distinction of tradable vs. non-tradable sectors. The categories of goods and services are an approximation in the sense that some service products assumed to be non-tradable like electricity or financial services are tradable. The tradable/non-tradable sector distinction is critical because of the price responsive is based on differences in the demand structures that each sector faces. For tradable goods and services we assume: 1) more of the demand tends to be located outside the region, 2) the regional price conforms more nearly to the national and international price, and 3) demand is more elastic from the point of view of regional producers. We assume the opposite for non-tradable goods and services. These critical assumptions to the analysis are not justified for goods and services sectors per se but only as they approximate tradable and non-tradable sectors. This is a subtle but important distinction that should be pointed out and illustrated clearly in the literature in our view. Our analysis clearly follows the conceptual assumptions made about the differences in price elasticities for the traded and non-traded sectors. The traded sector derives greater benefit from the property tax cut than the non-traded sector. This is a function of both the property tax rate (burden) on each sector and the elasticity of demand for their products. We can forecast a coherent story of the effect of a tax cut. The traded sector increases its demand for labor and it bids capital away from the non-traded sector. Output increase in the traded sector is greater than in the non-traded sector. Household income in the region goes up and this in turn is more beneficial to the non-traded sector than to the traded sector. However, the traded sector is able to increase exports by much more than the non-traded sector because a larger part of demand for the traded goods and services is more elastic than it is for the non-traded sectors. Our model provides the correct conceptual insight into why it is important in regional economics to expect differential impacts of public policies on traded and non-traded price responsive in different parts of the regional economy.

Impact:
We predict that for every $3 reduction in property taxes there would be a $2 loss in state and local tax revenue.

2. INTEGRATED SOCIAL, ECONOMIC, AND FISCAL MODELS FOR RURAL IDAHO

Investigators: Taylor, R. G.
Termination Date: 06/30/2005
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
The research project, The Value and Impact of Idaho's Grape and Wine Industry was completed in 2002. The research was divided into three parts: (1) estimating costs of production to establish and grow vine grapes in southwestern Idaho; (2) estimating the impacts of the grape and wine industry in Idaho; and (3) valuing the growing wine tourism industry in Idaho. Many wineries produce a dual product; commercial wine and wine tourism. Growth of wine tourism has been phenomenal, while grape production has glutted the market. Idaho's eleven wineries produce over 165,000 cases of wine annually; grape growers cultivate 1,000 acres to produce $3.6 million of grapes; wine sales were $15 million from tasting rooms and via wholesale; more than 100 people are employed in the industry. Grape and wine exports from Canyon County to the rest of Idaho and other states generates a potential of $22 million in sales and 142 jobs in Canyon County; grape and wine exports from Idaho to other states generate $15 million in sales and 124 jobs in Idaho The demand for wine tourism visits for Canyon County in southern Idaho was estimated using the Travel Cost Method. The value of wine tourism in Canyon County was estimated to be $5.40 per person per trip and trip demand was highly inelastic (0.5). Elasticities of other trip demand function variables were estimated and analyzed, with a view to marketing of Idaho's emerging wine tourism industry. The costs and returns estimates developed in this study are based on assumptions of input prices, wine grape markets, labor availability, site conditions, cost of capital, and weather - all of which can have substantial influence on vineyard profitability.

Impact:
This study has documented that Southwestern Idaho has the potential to become a nationally recognized grape-growing region.

3. FAMILY AND WORK IDENTITIES DURING TIME OF TRANSITION
Investigators: Schmiege, C. J.
Termination Date: 09/30/2005
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
Data collection in Sandpoint, Idaho has begun. Both quantitative and qualitative data have been collected from one fourth of the prospective sample. All qualitative interviews to date have been transcribed and coded. A model of women's identity development and change was developed. The results thus far suggest that womens identity development in adolescence makes a significant impact on their choices for what is termed planful competence and later life choices in the arenas of work and family. Although past research has concentrated on middle class women, or poor urban women, our research specificially targets poor, rural women. Continuing to focus on the intersection of identity development and change in response to life transitions in work and family should provide us with unique information to share with educators and policy makers.

Impact:
Little information exists about the lives of poor, rural women and their experiences in work and

family. By analyzing the specific issues they face we will be better able to develop and implement extension programming relative to their needs.

4. RURAL COMMUNITY WELL-BEING AND ENVIRONMENTAL HEALTH
Investigators: Wulfhorst, J. D.
Termination Date: 06/30/2006
Reporting period: 01/01/2002 to 12/31/2002

Progress Report:
A social assessment of the Idaho Panhandle National Forests was completed in August 2002. Major findings include significant and rapid community change throughout the Panhandle. Communities are experiencing economic and social transitions at varying rates with differential impacts. Tribes within the Panhandle are not integrated into federal forest management. These findings are significant because the Panhandle Forests are historically one of the most roaded and logged forests in the Northwest, and currently experience above-average use from urban recreationists migrating in and out of the region for leisure, retirement, and tourism. Proximate urban areas have a substantial effect on the Idaho Panhandle rural communities. Preliminary assessment from ongoing fieldwork reveals a significant impact to Idaho's Kentucky Bluegrass Farmers from an impending lawsuit to require them to stop burning plant residue in their fields. A growing grassroots movement among surrounding communities blames bluegrass farmers for chronic health symptoms among community members. Survey data collected from residents near and employees of the Idaho National Engineering and Environmental Laboratory (INEEL) indicate higher than normal perceptions of risk. Employees, more so than residents-at-large, recognize the importance of economic and social benefits the Lab brings to southeastern Idaho. Most respondents also understand the geography and subsurface scientific pattern of water flow in the Snake River Plain aquifer as indicated by survey results. Combined, these results indicate the need to address public concern rather than fail to involve the public in activities associated with their economic and environmental livelihoods.

Impact:
The Social Assessment for the Idaho Panhandle National Forests will be used by the Forest Service to guide the social dimensions of their upcoming Forest Revision process. The agency is grappling with how to address public concern and allow for participation, but has grown increasingly concerned about ongoing litigation that often prevents efficient forest management. Data analysis within the project on burning bluegrass residue will be vital to offering a critical assessment of what has become a highly emotional as well as political issue and threatens to end the farming career of an entire set of individuals as well as a strong basis for a number of rural economies in this region. Data collected on risk perceptions related to INEEL operations has and will continue to develop a baseline of understanding for connecting the Lab to its primary constituents.

Allocated Resources IAES Program 9:

RPA	SY	PY/TY	Amount
608	1.38	0	$112,374
801	.44	0	$62,008
802	0	0	$14,165
803	1.87	0	$167,925
901	2.13	0	$123,037
902	0	0	$29,067
Total	5.82	0	$508,576

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IAES Allocated Resources by Federal REE Goal:

Goal	SY	PY/TY	Amount
1	**46.61**	**33.12**	**12,662,170**
2	**1.95**	**2.89**	**1,069,358**
3	**1.23**	**0**	**524,024**
4	**10.35**	**4.0**	**3,062,474**
5	**5.82**	**0**	**508,576**
Total	**65.96**	**40.01**	**17,826,602**

Multi-state Research Projects: Research activities of the IAES that contribute to organized multi-state projects/programs approved by CSREES are designated as Regional Research Projects. Regional/multi-state research supported by Section 3(c)3 of the Hatch Act is appropriate for support of research when: 1) the research focuses on a specific and important problem of concern to two or more states, and 2) the research is planned and conducted as a concerted effort in which the participating scientists are mutually responsible for accomplishing the objectives. Multi-State (Regional) Research Projects Outlines in which the University of Idaho participates are subject to peer review and approval as stated in the policy manual of Western Association Agricultural Experiment Station Directors (WAAESD) or those of the other SAES Regions if the multi-state project originated outside of the Western Region.

WAAESD delegates responsibility for review of Western Coordinating Committees (WCC's) to the Regional Coordination and Implementation Committee (RCIC). The purpose of WCC activities is to bring research and extension (and to a limited extent academic) faculty together to coordinate related research without the need for a formal Multi-State Research Project outlines. WCC's have the authority to organize technical conferences, work groups, task forces and symposia.

In the Western Region, Multi-State (Regional) Research Fund projects must be reviewed by a maximum of four outside peer reviewers in addition to the Research Implementation Committee (RIC) appointed by the WAAESD. The RIC reviews the proposal and makes a recommendation to the WAAESD. If the proposal is approved, WAAESD Chair with assistance from the WAAESD Executive Director Office transmits the project to CSREES. The RIC also appoints Administrative Advisors to guide and administer projects and committees.

In summary, the procedures for scientific peer review employed for all IAES research projects, which have been in place for more than a decade (coupled with those of WAAESD for official Multi-State Research projects), more than comply with the peer review requirements specified in the Agricultural Research, Extension, and Education Reform Act (AREERA) of 1998.

Multi-State Research Activities

The University of Idaho is a relatively small Land-Grant institution and one whose location is relatively remote. In this context, faculty at the university have been very active in multi-state programming for a number of years as a means to interface with other colleagues in specialty areas of their disciplines and to build the critical professional mass needed to be competitive in research programming. This is especially true of research faculty affiliated with the Idaho Agricultural Experiment Station. This is reflected in our current participation in formal Multi-State (Regional) Research Projects, Western Region Coordinating Committees, and the less structured multi-state and multi-discipline collaborations that are imbedded in the majority of IAES Hatch research projects. The IAES's current Multi-State (Regional) Research Project portfolio involves participation of 23 IAES faculty in 21 different approved Multi-State Research Projects. Of these, 14 projects originate in the Western Region, four in the North Central Region, two in the Southern Region, and one in the North East Region. Currently, the IAES is spending over 27% of its Federal Hatch formula funds ($591,700) in support of these Multi-State Research Projects plus $336,195 in state funds. The following figures detail the IAES resource allocation to multi-state activities:

Multi-state Summary of Resources Allocated by Federal REE Goal

Goal	SY	PY/TY	Amount
1	**3.66**	**4.81**	**$586,952**
2	**.45**	**1.00**	**$97,439**
3	**.14**	**0**	**$10,931**
4	**.58**	**0**	**$169,861**
5	**1.97**	**0**	**$187,134**
Total	**6.80**	**5.81**	**$1,052,317**

*** Includes federal appropriation of $589,420 and state dollars of $462,897.**

Integrated Program Activities

Long before AREEA and traditionally, the Idaho Agricultural Experiment Station (IAES) and the College of Agricultural and Life Sciences (CALS) have placed a strong emphasis on the integration of research and extension programming. This is evidenced by the fact that a large number of employees in the college have official joint research and extension responsibilities as codified in official position descriptions and combined appropriated funding from both research and extension for salaries. The IAES has 70.7 SY's distributed over approximately 110 faculty members. Of these, a total of 18.5 SY's (full-time equivalents, FTE's) representing 50 different faculty program leaders are funded by a combination of research and extension appropriated resources and, accordingly, have official responsibility for both research and extension programming and the integration of these two domains of professional activity. Likewise, the IAES has a total of 114 FTE of research support positions (PY's and TY's) funded by appropriated resources. Of this total, about 26.2 FTE (PY and TY) distributed over 57 individuals are supported by both research and extension salary resources. In summary, of the 214 full-time positions in the IAES, 107 individuals are supported by a combination of research and extension funds and have responsibility for the integration of research with extension programming. The below table summarizes this information and provides the corresponding fiscal data.

IAES Integrated Program [(a)] and Distribution of "Hatch" and Idaho Research Funds for Salaries(SY, PY, & TY), Fringe Benefits, and Operational Support

			Total Integrated Program Expenditures		
Position Category	Number of Individuals	FTE[(b)]	Federal "Hatch" Funds($)[(c)]	Idaho Research Funds($)[(c)]	Total ($)
SY	50	18.5	224,620	1,578,114	1,802,734
PY & TY	57	26.2	152,990	1,074,858	1,227,848
Totals	107	44.7	$377,610	$2,652,972	$3,030,582

(a) For this tabulation "intergrated program" effort and expenditures for the Idaho Agricultural Experiment Station (IAES) only include faculty and support staff whose appointments have both research and extension responsibilities and are supported by both research and extension funding. Many other IAES integrated program efforts not officially codified in budget documents are not included in this tabulation of effort and fiscal resources

(b) FTE = full time equivalents.

(c) In the IAES, both Hatch and state research fund appropriations are pooled and then allocations are made to specific programs from the total pool of appropriated support funds. These values were derived by calculation. The total IAES Hatch funding pool is $2,026,200 and the IAES appropriation from the State of Idaho is $14,234,000. Thus, Hatch funds account for 12.46% of the IAES's total appropriated financial resources. This relationship between Hatch and Idaho-based research funding was used to calculate the Hatch and State of Idaho contributions to integrated research/extension programming from total research expenditures for integrated programs

Stakeholder Input

Within the College of Agricultural and Life Sciences (CALS), the Idaho Agricultural Experiment Station (IAES) relies on the avenues of stakeholder input employed across the college. The IAES plan of work was derived with the input from and has been shared with a broad cross-section of stakeholders in Idaho. In brief, the major stakeholder groups providing input regarding the IAES's spectrum of research activities (as reflected in the portfolio of IAES research projects and the plan of work) include:

- The college's Agricultural Consulting Council (ACC) which was an 80 member organization composed of representatives selected by virtually every agricultural, food system, and family and consumer science organization within the state. This advisory group has traditionally been the primary stakeholder group with which the college and IAES have had significant interactions in terms of areas of program development and emphasis and, accordingly, the current plan of work. In 2001, CALS began reorganization of the Agricultural Consulting Council into a smaller more focused and dedicated group that will be know as the "Dean's Advisory Council". This new college level advisory group was instituted in 2002. Many members of the ACC have transitioned into serving on the departmental advisory committees that have been formed in all the academic departments of CALS (see below).

- Idaho Cooperative Extension has citizen advisory groups in 42 of Idaho's 44 counties. These committees, which are composed of a very diverse and broad mix of public interests, provide input regarding extension and research program priorities from the county perspective.

- Idaho's 17 agricultural commodity commissions and organizations provide advice specific to commodity based programs and appropriate disciplines and departments within the college.

- The IAES research project portfolio and an abbreviated version of the plan of work is annually shared and discussed with representative from the executive branch of state government including the Governor's Office, the Dept. of Agriculture, and to a lesser extent, the Dept. of Environmental Quality, Dept. of Health and Welfare, and the Dept. of Commerce as well as being shared/discussed with key committees and leadership of the Idaho Legislature.

- The faculty, staff, and students (both graduate and undergraduate) of the college have a vested interest in the development of appropriate research programs of high quality that are responsive to needs of the state and region. This university stakeholder group is an important source of valuable input to the IAES and play a major role in IAES program development and delivery.

The college has expanded its involvement with stakeholders by forming advisory committees for each of the eight academic departments in CALS. Now (the 2002 reporting period), all departments have established advisory committees. These committees (ranging between 6 to

12 members) are composed from a broad base of stakeholders sharing interest in the disciplines, programs, and strategic plan of the department. These committees are a significant additional source of stakeholder input for the IAES and CALS. In addition, once a year in on-campus meetings the departmental advisory committees meet with the CALS and IEAS leadership as well as with the Dean's Advisory Council on program priorities and directions for the college, the experiment station and the departments.

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