

FY 2000 Annual Report of Accomplishment and Results

**Colorado State University
Agricultural Experiment Station**

A. Overview

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

*CSU Program 1: Plant and animal improvement and new agricultural
development*

Summary

As part of this program a number of significant accomplishments and results were obtained this year in the following areas.

In the area of Reproductive efficiency of livestock: A new set of expected progeny differences (EPD) tests were developed for economically relevant traits. A publication on this work has been reprinted in several national industry publications.

In the area of plant breeding and gene expression technology: Two new potato cultivars were released this year and release notices for three additional cultivars are in preparation that should be released next year. A new black bean cultivar “Shiny Crow” that contains a shiny seed coat luster was released this year. This is the first such release in the US. This program improved and developed new technologies to facilitate insertion of genes into economically important plants and furthered work to determine the biochemical and physiological processes controlling important plant traits.

In the area of Genome mapping: The genome location of a Fusarium wilt resistant gene in common bean was demonstrated. This will enable streamlining selection of disease resistant bean cultivars.

Key Themes: Animal Production Efficiency, Animal Genomics

Short Description - AES researchers are developing the next generation of expected progeny differences (EPD). Emphasis is placed on developing EPD's for economically relevant traits; traits that are directly

associated with either a cost of production or a revenue stream. Current work is focused on female fertility traits, cost of feedlot finishing traits, and cow maintenance costs.

Impact - In 2000 the first heifer pregnancy EPDs were successfully developed and produced in prototype and production mode based on pregnancy observations. Additionally, it developed and produced the first EPDs for carcass traits based on both slaughter progeny data and ultrasound data from yearling seedstock. Also, a prototype mature cow maintenance EPD was developed and tested. Particularly important was the proceedings paper at the Beef Improvement Federation Annual Meeting on Economically Relevant Traits. This work has been reprinted in several national industry publications and is receiving substantial attention.

Golden, B. L., D. J. Garrick, S. Newman, and R. M. Enns. 2000. Economically Relevant Traits A Framework for the Next Generation of EPDs. Proc. Beef Improvement Federation.

Source of Federal Funds – Hatch Act funds

Scope of Impact – State Specific

Key Themes: Plant Production Efficiency, Plant Germplasm, Plant Health

Short Description - The basic objective of the Colorado potato-breeding program is to develop new potato cultivars with increased yield, improved quality, resistance to diseases and pests, and tolerance to environmental stresses.

Impact - Release notices for the cultivars Keystone Russet (AC83064-1) and the Silverton Russet (AC83064-6) were completed in 2000. Release notices are in preparation for Cherry Red (DT6063-1R), Fremont Russet (CO85026-4), and Durango Red (CO86218-2). BC0894-2, a chipper with international export potential, will be recommended for release and naming in 2001. Plant Variety Protection is pending for Russet Norkotah Selections 3 and 8.

It is estimated that the value of the 1999 fall potato crop in Colorado was increased by \$10-12 million due to improved yield and quality associated with new potato cultivars and clonal selections of established cultivars.

Source of Federal Funds – Hatch Act funds

Scope of Impact – State Specific

Key Themes: Plant Production Efficiency, Plant Germplasm, Plant Health

Short Description - The Dry Bean Research Program at Colorado State University participated in the annual evaluation of national and regional bean nurseries for yield, adaptation, and reaction to diseases. In addition to evaluation of bean cultivars, the breeding program develops commercial cultivars in the pinto and black bean market classes for use in the western US and High Plains. Cultivars are developed that possess stable resistance to rust, common blight and root rot.

Impact - The breeding program released a new black bean cultivar 'Shiny Crow' that possesses shiny seed coat luster. It is the first such released in the US. Enhancement of disease forecasting programs reduced the number of fungicide applications (by 1 to 2 sprays), grower costs (by \$ 25 to 50 / Acre) and environmental exposure (by 10 to 20 % less pesticide) for producers.

Source of Federal Funds – Hatch Multistate

Scope of Impact – Multi-State Research

With States: CA, FL, GA, ID, MI, NE, NYC, ND, OR, PR, WA, WI

Key Themes – Plant Genomics

Short Description - Overall goal of the project is to obtain molecular genetic information on quantitative trait inheritance that is useful to CSU's applied plant breeding programs and to the larger community of plant breeders and geneticists. This year the emphasis of the project was on the identification of a major locus for Fusarium wilt resistance in common bean. Fusarium wilt, caused by the vascular pathogen *Fusarium oxysporum* f. sp. *phaseoli* (FOP), is an increasing problem in bean production areas of the western U.S.

Impact – The result of this project is the first to demonstrate the genome location of a Fusarium wilt resistance gene in common bean. The large effect of the gene and the closely linked marker that was identified will enable the development of marker-assisted selection strategies for streamlined selection of disease resistant bean cultivars.

Source of Federal Funds – Hatch Act funds

Scope of Impact – State Specific

CSU Program 2: Plant and animal production systems.

Summary

As part of this program a number of significant accomplishments and results were obtained this year in the following areas.

In the area of cropping systems: Separate seeding rates were determined for limited irrigation grain sorghum and corn depending on irrigation method. It was determined that selecting the proper seeding rate could increase grower profit by \$4.50 to \$7.30/ha. An ongoing effort studying no-till and minimum till practices in dryland systems has concluded that 3 or 4 year rotations are superior to 2 year wheat-fallow systems; they increased annualized grain production by 70% and economic return by 25-40% compared to wheat-fallow. About 1,419,900 acres have been converted from wheat-fallow to wheat-summer crop-fallow due to the results from this project.

In the area of ornamental/green agriculture, urban gardening: Over 950 varieties of annual flowers were grown and evaluated for adaptability to the high plains environment. A performance report was published and distributed to all cooperators and industry personnel. Landscape plants were evaluated for inclusion in the plant selection program offerings in 2000.

In the area of animal well-being: The use of an alkaline nondenaturing, continuous fluid-phase, one-step ultrafiltration method to quickly and efficiently isolate low molecular weight peptide growth factors was established, published and patented.

Key Themes – Ornamental/Green Agriculture, Urban Gardening

Short Description - Selection, introduction, and evaluation of landscape plant materials suitable for the High Plains.

Impact - Over 950 varieties of annual flowers were grown and evaluated during the 2000 season and a performance report was published and sent to all cooperators and industry personnel. As a result of these trials, New Guinea Impatiens have become a more important annual flower crop in the state. Five plant species were recommended or introduced to the trade and public by Plant Select in 2000. Over 175,000 of the 2000 Plant

Select plants were tagged or sold in 2000. Bedding plant growers and consumers throughout Colorado and the region look to Colorado State for evaluation of both seed and asexually propagated bedding plant varieties.

Source of Federal Funds – Hatch Act funds

Scope of Impact – State Specific

Key Themes – Plant Production Efficiency

Short Description - In Southeastern Colorado, irrigation water is pumped from deep wells. Irrigation costs are much higher in this region than in areas with shallow wells, or from ditch water in river basins. The current low commodity markets for crops combined with high-energy costs make limited supplemental irrigation more profitable than full irrigation for row crop production in this area. As part of this project seeding rate studies were conducted on limited furrow and sprinkler irrigation for both grain sorghum and corn to determine the optimum-seeding rate for these crops.

Impact – Separate seeding rates were determined for limited irrigation grain sorghum and corn depending on irrigation method, a lower seeding rate for furrow irrigation, approximately, 25,000 seeds/ha for grain sorghum and 8,000 seeds/ha for corn, and a higher seeding rate for sprinkler irrigation, approximately, 45,500 seeds/ha for grain sorghum and 10,500 seeds/ha for corn. Therefore, selecting the proper seeding rate for limited irrigation based on irrigation method would increase grain sorghum and corn yields 314 to 753 kg/ha, bolstering grower profit \$4.50 to \$7.30/ha.

Source of Federal Funds – Hatch Act funds

Scope of Impact – State Specific

Key Themes – Plant Production Efficiency, Agricultural Profitability

Short Description - The working hypothesis for this project is that no-till and minimum till practices allow cropping system intensification beyond the long-term standard system of wheat-fallow because no-till improves capture and retention of the incident precipitation. After 12 years of research, it has been concluded that cropping systems with 3- and 4-year rotations are superior to 2-year wheat-fallow systems; they increased annualized grain production by 70% and economic return by 25-40% compared to wheat-fallow.

Impact - There has been a conversion of about 1,419,900 acres in CO from wheat-fallow to wheat-summer crop-fallow. This has resulted in an increase in net return of about \$17,748,750 per year, based on an increased return of \$12.50/acre as indicated by previous economic analysis. The net effect on the environment is positive because the new systems provide high amounts of year around cover that reduce soil erosion by 80 to 99%, which in turn improves both air and surface water quality.

Source of Federal Funds – Hatch Act funds

Scope of Impact – State Specific

Key Themes – Animal Health

Short Description – This project encompasses the broad area of mammalian growth and its regulation by hormones and growth factors.

Impact - Methods to isolate polypeptide growth factors from defatted bovine colostrum have been identified and examined. Comparison of the use of acid, alkaline and high ionic strength buffers in ultrafiltration of bovine colostrum was completed. The use of an alkaline nondenaturing, continuous fluid-phase, one-step ultrafiltration method to quickly and efficiently isolate low molecular weight peptide growth factors was established, published and patented. The method removed more than 95% of colostrum protein and resulted in a fraction that is enriched in IGF-I and IGF-II.

Source of Federal Funds – Hatch Act funds

Scope of Impact – State Specific

CSU Program 3: Safe and effective management of pests

Summary

As part of this program a number of significant accomplishments and results were obtained this year in the following areas.

In the areas of pest biology and ecology: Much of the information used in the publication (2000) of “Insects and Diseases of Woody Plant in the Central Rockies” was generated by an AES project. This publication has rapidly been adopted by the Green Industry in the region as the predominant resource on woody plant pest diagnosis and management.

In the area of Genome mapping: New novel wheat genes that are induced due to Russian wheat aphid infestation have been identified and known resistant genes have also been identified. These genes will be used to selectively develop new varieties of wheat that are resistant to Russian wheat aphid infestation.

In the area of weed management: A model has been developed for making weed management decisions in irrigated corn. The model has been tested with 50 corn producers with very favorable results; it reduced herbicide use by 16% and increased gross margin by \$11.6/acre compared to growers' practices.

It has been determined that Russian knapweed is aggressive and must be managed to promote desirable vegetation on different rangeland restoration sites.

Data developed in one of our projects was used to establish a delayed pre-emergence use for pendimethalin in dry bulb onions to provide growers with an inexpensive solution to control important weeds during stand establishment.

Key Themes – Invasive Species

Short Description – Develop information on biology and control of woody plant insects.

Impact - This project provided much of research base for the publication "Insects and Diseases of Woody Plants of the Central Rockies". Published in Spring 2000 it has rapidly been adapted by the Green Industry in the region as the definitive resource on woody plant pest diagnosis and management. Approximately 1,000 copies of this 284-page full color publication were sold within the first six months of its release.

Source of Federal Funds – Hatch Act funds

Scope of Impact – State Specific

Key Themes – Plant Genomics

Short Description – This project tried to isolate possible wheat gene(s) that confer resistance to Russian wheat aphid infestation. A resistant wheat variety developed at Colorado State University was used as a source of genes because genes must be expressed in this variety that render the plant resistant to Russian wheat aphid infestation.

Impact - New novel wheat genes that are induced due to Russian wheat aphid infestation have been identified and known resistance genes were also identified. These genes represent important new, potential genetic markers that may be used to selectively develop new varieties of wheat that are resistant to Russian wheat aphid infestation.

Source of Federal Funds – Hatch Act funds

Scope of Impact – State Specific

Key Themes – Invasive Species

Short Description – Determine the encroachment rates of Russian knapweed (*Acroptilon repens* (L.) D.C.) and its ecological relationship to desirable vegetation on different rangeland sites.

Impact - Before this work, many weed scientists and weed managers assumed that site restoration would occur without additional input. Site revegetation now is considered an integral part of noxious weed management.

Source of Federal Funds – Hatch Act funds

Scope of Impact – State Specific

Key Themes – Invasive Species

Short Description - The Colorado corn bioeconomic modeling project aims to develop a robust version is available for making weed management decisions in irrigated corn. At this point the General Weed Model (GWM) has been developed which is a stand-alone software program written in Visual Basic. Much of the weed-corn competition data generated by the regional NC-202 project has been used to parameterize competitive interactions in the model as described by equations.

Impacts - The model has been tested with 50 corn producers with very favorable results; it reduced herbicide use by 16% and increased gross margin by \$11.60/acre compared to the growers' practices.

Source of Federal Funds – Hatch Multistate

Scope of Impact – Multi-State Research

Key Themes – Invasive Species

Short Description - Weed control in onions continues to be a significant

input cost for growers; and with limited options for weed management, hand weeding is still necessary. Research has focused on developing new weed control technologies to replace DCPA for pre-emergence weed control.

Impacts - Data generated by this research was used to establish a delayed pre-emergence use for pendimethalin in dry bulb onions. This provided onion growers with an inexpensive way to control important weeds like kochia, lambsquarters and pigweed during stand establishment. This is the most critical period for weed management in onions.

Source of Federal Funds – Hatch Act funds

Scope of Impact – State Specific

With States: IN, IL, IA, KS, MI, MN, MO, MT, NE, ND, OH, SD, TX

USDA Goal 2 and Goal 3: A Safe and Secure Food and Fiber System and a Healthy, Well Nourished Population

CSU Program 4: Food Safety and Nutrition

Summary

As part of this program a number of significant accomplishments and results were obtained this year in the following areas.

In the area of improved processes for food processing: The results of one of our projects indicates that bacterial pathogens may survive for several days in acid, and proliferate in water washings of meats, serving as potential sources of product contamination. In another study it was determined that pretreating slices of apples or beef prior to drying with a short-time immersion in varying levels of common household acidulants may serve as an effective pre-drying treatment to minimize the risk for E. coli O157:H7 in home dried products.

In the area of medicinal plants: A patent application has been filed covering the use of the discovered S. aureus bacterial resistance inhibitors.

Key Themes – Food Safety

Short Description - Meat safety has been at the forefront of societal concerns in recent years as the number and complexity of food safety issues have increased substantially. Animals, which are the reservoir for bacterial foodborne pathogens of enteric origin, are considered as the major source of bacteria that cause current food safety concerns. Feces from animals that harbor foodborne pathogens contaminate meat and/or contaminate the environment resulting in cross- contamination of other

foods.

Impact - *Listeria monocytogenes* died off after 7, 2-7, and 1 days in acid washings at 4, 10, and 35 degrees C, respectively. In nonacid washings, the pathogen increased in counts (1-2 log CFU/ml), irrespective of natural flora, which, when present, outgrew (8 log CFU/ml) *Listeria monocytogenes* after 1, 2, and 4 days at 35, 10, and 4 degrees C, respectively. The pH of acid washings remained unchanged, while that of nonacid washings decreased or increased depending on absence or presence of natural flora. The results suggested that, depending on its growth rate and metabolic activity, the natural flora of a food environment may harden or weaken pathogenic bacteria to acid stress and, thus, have a potential effect on food safety. In another study, inoculated *Salmonella Typhimurium* DT104 died off in lactic and acetic acid washings by day 2 at 4 or 10 degrees C, while *Escherichia coli* O157:H7 survived for at least 2 and 7 days in lactic and acetic acid washings, respectively, especially at 4 degrees C. These results indicate that bacterial pathogens may survive for several days in acid, and proliferate in water washings of meat, serving as potential sources of product contamination.

Source of Federal Funds – Hatch Act funds

Scope of Impact – State Specific

Key Themes – Food Safety

Short Description - *Escherichia coli* O157:H7 has been known to cause illness from unpasteurized fruit juices and dehydrated meat products. Previous work has shown that *E. coli* O157:H7 survives the heat of dehydration on inoculated beef strips and apple slices. Studies were conducted to determine the effect of various acidic pretreatments on the survival of *E. coli* O157:H7 on beef strips and apple slices during dehydration. *E. coli* O157:H7 has been shown to survive home-drying methods commonly used for beef strips and apple slices.

Impact - Pretreating slices prior to drying with a short-time immersion in varying levels of common household acidulants (e.g., ascorbic acid, citric acid, lemon juice) may serve as an effective pre-drying treatment to minimize the risk for *E. coli* O157:H7 in home-dried products.

Source of Federal Funds – Hatch Act funds

Scope of Impact – State Specific

Key Themes – Medicinal Plants

Short Description – Detect and identify natural toxicants and antitoxicants in food, food supplements, and herbal products.

Impact - The *S. aureus* antibacterial resistance inhibitor methoxyhydrnocarpin-D (previously identified from a Colorado native plant) has been synthesized in the laboratory. The synthesis was also extended to structural derivatives and those parts of the molecule important for bioactivity were identified. This resulted in preparation of a simple flavone derivative with potent activity, which can be prepared on a large

scale if necessary. In collaboration with Tufts University, an anthraquinone derivative present in rhubarb was found to be a substrate for a resistant E. coli efflux pump and this provided the first step for possible identification of natural compounds which might inhibit the pump. Colorado State University, in conjunction with Tufts University, has filed a patent application covering use of the discovered S. aureus bacterial resistance inhibitors.

Source of Federal Funds – Hatch Act funds

Scope of Impact – State Specific

USDA Goal 4. Greater Harmony Between Agriculture and the Environment

CSU Program 5. Agriculture and environmental quality

Summary

As part of this program a number of significant accomplishments and results were obtained this year in the following areas.

In the area of water and soil quality: A biosensor for Atrazine has been developed that can be used for in situ monitoring of ground or surface waters. Another project developed and tested a rapid (less than 1 day) continuous method for measurement of soil water retention and hydraulic conductivity functions.

In the area of nutrient management: Production level management zones have been shown to be as effective as intensive grid soil sampling for managing variable rate N fertilizer, and less costly to implement. Research results have shown that Zn fertilizers must be 50% water soluble and the maximum effectiveness ratio of organic vs. inorganic sources is 4:1 or less, not 10:1 as was previously claimed by many marketers. The Zn research was published in popular form in the Farm Chemicals magazine that has a circulation of over 24,000 subscribers. Producers, consultants, and fertilizer dealers are using this information to better serve producers.

Key Themes – Water Quality

Short Description - Halogenated pesticides, used in Colorado and every other state, have impacted water supplies. For example, both atrazine and alachlor have been detected in ground and surface waters in Colorado at levels that exceed the drinking water MCLs. Current methods of detecting and monitoring specific compounds in waters are expensive, time consuming, and require sample removal, which can disturb the composition. An attractive option is the development of inexpensive sensors of particular agricultural chemicals that could be used in situ to monitor ground or surface waters. This project has developed an enzyme-based sensing strategy that results in fiber optic biosensors capable of detecting chlorinated organic compounds at low concentrations.

Impact - A biosensor for atrazine has been developed. The biosensor's measurements

were calibrated against a traditional gas chromatographic analysis with excellent agreement (and a small fraction of the analytical time). This work is significant because no other device for inexpensive, continuous, real time, in situ monitoring of atrazine has been developed. Sensors of this type would be useful for monitoring water supplies (ground, surface, or waste water), especially if sensors for different compounds were bundled together. Since atrazine is a widely used herbicide, this biosensor is of importance to the agricultural community.

Source of Federal Funds – Hatch Act funds

Scope of Impact – State Specific

Key Themes – Nutrient Management, Recycling

Short Description - Water-treatment residuals (WTR) can adsorb large quantities of P; thus, they can possibly be used to mitigate P input into fresh-water systems from over application of sewage biosolids or feedlot manure. One unanswered question is how stable is the adsorption of P onto WTR. The WTR desorption studies show that adsorbed P is held tightly and may transform to even more stable forms over 3 months.

Impact - These results provide economic benefit to cities since land application provides the less expensive means of biosolids recycling. These studies show that long-term recycling of biosolids on dryland wheat and wildfire-burn areas is socially, environmentally, and economically sustainable. The wildfire-revegetation study results suggest that the application of biosolids can provide quick establishment of vegetative cover to prevent soil erosion and will affect plant biomass and canopy cover for four growing seasons after application.

Source of Federal Funds – Hatch Act funds

Scope of Impact – State Specific

Key Themes – Soil Quality

Short Description - Estimation of soil hydraulic properties is a critical component in predicting fate and transport of chemicals in soil. Because of soil heterogeneity across the large spatial scales often considered, sampling requirements (and subsequent analysis) can be an overwhelming task which, when unfulfilled, limits the success of predictive modeling efforts.

Impact - A continuous flow method has been developed and tested that allows rapid (less than 1 day) measurement of soil water retention and hydraulic conductivity functions. This inverse approach is similar to established single or multi-step outflow methods but does not use equilibrium steps and hence is much faster. The continuous flow method mimics natural flow situations (air-pressure displacement is not used) and is equally suited to measuring wetting and/or draining functions. In laboratory tests on both coarse and fine textured soils, continuous flow method results are in outstanding agreement with results of traditional analyses requiring several weeks of effort.

Source of Federal Funds – Hatch Act funds

Scope of Impact – State Specific

Key Themes – Nutrient Management

Short Description – Evaluation of fertilizer management.

Impact - Production level management zones have been shown to be as effective as intensive grid soil sampling for managing variable rate N fertilizer, and less costly to implement. Many Zn fertilizers are on the market with manufacturers making unsubstantiated claims of specificity. This research has shown that Zn fertilizers must be 50% water soluble and the maximum effectiveness ratio of organic vs. inorganic sources is 4:1 or less, not 10:1 as was previously claimed by many marketers. The Zn research was published in popular form in the Farm Chemicals magazine that has a circulation of over 24,000 subscribers. Producers, consultants, and fertilizer dealers are using this information to better serve producers.

Source of Federal Funds – Hatch Act funds

Scope of Impact – State Specific

USDA Goal 5. Enhanced Economic Opportunity and Quality of Life for Americans

CSU Program 6. Rural and community development

Summary

As part of this program a number of significant accomplishments and results were obtained this year in the following areas.

In the area of agricultural and natural resource policy: This research provided county, state and federal decision makers with this information for areas in Colorado and elsewhere as well as providing benefit transfer methodologies to predict the open space and recreation values with very little additional data collection.

In the area of family resource management: A project focused on changing gender roles in dual earner families. One of the most important findings challenged gender stereotypes that resulted in a reconceptualization of domestic labor, incorporating previously "invisible" aspects of family work and reflecting modern life.

In the area of community development: One of the projects organize and provide technical, logistic, training, and facilitation support for community-based, collaborative stakeholder groups who want to accomplish land use planning, problem solving and management. As a result three Internet-based courses that are now available in rural areas, including tribal lands, of Colorado and the Western US. Each course is highly relevant in providing a common knowledge base individuals and groups involved in land use decision making.

Key Themes – Rural economic development

Short Description - The benefits and costs of open space and recreation are often needed by public decision makers to improve the management of these resources on public and private lands.

Impact – This research provided county, state and federal decision makers with information for areas in Colorado and elsewhere as well as providing benefit transfer methodologies to predict the open space and recreation values with very little additional data collection. Method for Estimating the Economic Value of Open Space in Colorado Using Transactions Evidence: A multiple regression equation that predicts the market value of open space in Colorado as a function of site characteristics was developed in response to a request by stakeholders in Colorado. The predictive models for open space and recreation values allow public agencies to calculate their own site specific values for decision making. The open space model should be useful as an alternative appraisal tool for county governments in determining what is a fair market value to pay for open space. The visitor use forecasts for Rocky Mountain National Park will assist in sizing transportation investments to meet projected visitor demand.

Source of Federal Funds – Hatch Act funds

Scope of Impact – State Specific

Key Themes – Family Resource Management

Short Description - Colorado investigators focused on changing gender roles in dual earner families. One of the most important findings challenged gender stereotypes in the area of expressive and instrumental family support. Men and women were most satisfied with their marital relationships when emotion work was balanced (both members of the couple performed at similar levels). This finding suggests that interventions aimed to balance emotion work in families promotes joint responsibility for the viability of the relationship. Thus, therapists should work with couples having difficulty to establish a "quid pro quo for the expression of caring."

Impact - The results of this project have resulted in a reconceptualization of domestic labor, incorporating previously "invisible" aspects of family work and reflecting modern life.

Source of Federal Funds – Hatch Multistate

Scope of Impact – Multi-State Research

With States: CA, ID, NM, OR, UT, WA; NON-SAES: PEI (Canada), IU (PA)

Key Themes – Community Development

Short Description - Organize and provide technical, logistic, training, and facilitation support for community-based, collaborative stakeholder groups who want to accomplish land use planning, problem solving and management. 2) Provide training for local individuals to perform all of the steps of the planning protocol, information management, plan implementation, monitoring, and adaptive management. 3) Identify and provide technical expertise for developing management alternatives for

agriculture, natural resources, the environment, and community development initiatives. 4) Provide and maintain an Internet resource network for communication and information access and sharing to help communities learn from each other.

Impact - Three Internet-based courses that are now available in rural areas, including tribal lands, of Colorado and the Western US. These areas are all undergoing profound demographic, economic, and cultural change. Each course is highly relevant in providing a common knowledge base individuals and groups involved in land use decision making, essential components of the RLUPMN. A pilot project is being implemented that will establish a network of Tribal Colleges and CSU to share on-line courses (CSU) and establish a group of tribal college instructors to serve a liaison function between tribal students and CSU faculty. Hopefully, this project will provide CSU expertise to Native American communities and will lead to more Indian students enrolling at CSU for degree programs. The Internet supported BLM Resource Advisory Committee training activities continue to be received very favorably as suggested by continuing requests by BLM management for this activity.

Source of Federal Funds – Hatch Act funds

Scope of Impact – State Specific

B. Stakeholder Input

The Colorado Agricultural Experiment Station (CAES) annually utilizes multiple means of obtaining stakeholder input on programs conducted and solicits input on changes in program direction. The CAES supports research in 22 departments on the Colorado State University campus as well as at 10 off-campus research centers. Programs at the research centers are administratively responsible to the Director of the CAES and coordinate with one or more academic departments. This year, each of the off-campus research centers held a public meeting where research results were presented and proposed programs were discussed. Additionally, research and outreach advisory committees at each research center reviewed ongoing and proposed research and made recommendations on long term research direction and goals. At the Western Colorado Research Center, two new program directions (sustainable fruit and vegetable production and container grown ornamentals) were adopted. Public input was solicited on all proposed programs, a survey was conducted and the results are presented in Section D. Evaluation of the Success of Multi and Joint Activities.

C. Program Review Process

All projects conducted by the CAES are subjected to a peer review process. Each College at Colorado State University has adopted a process for conducting a peer review on all CAES projects submitted for support by state and federal funds. Documentation is available upon request for the specific process adopted by each College and approved by the CAES Director.

D. Evaluation of the Success of Multi and Joint Activities

This year the CAES in coordination with the CSU Cooperative Extension held regional listening sessions to solicit further input on research priorities and program needs. Each year, a listening session will be held in different regions of the state. This year two listening sessions were held in the southeast and northwest areas of the state. A special meeting was held in Denver this year. All sessions were open to the public and advertised in the local media prior to the meeting. Below is a table summarizing the information collected from surveys conducted during the public meetings. The information collected at the meetings and summarized below is used to determine if there are special areas of concern to the citizens of the state. These results are used to determine if the CAES needs to conduct research in new areas or emphasize certain areas in which it already is conducting research. No significant changes to the current research efforts were needed based in the feedback obtained from the stakeholder groups.

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Question	Challenges for the future	Importance to:	Avg	Cnt	Importance					Importance				Gr
					Little		Great			Little				
					1	2	3	4	5	1	2	3	4	
1	Farm & ranch profitability/sustainability	Family	4.0	75	9	4	4	16	42	12.0%	5.3%	5.3%	21.3%	56
		Community	4.5	77	0	1	11	15	50	0.0%	1.3%	14.3%	19.5%	64
2	Value-added processing of raw agricultural & forest products; value-added enterprise development	Family	3.6	74	5	11	14	21	23	6.8%	14.9%	18.9%	28.4%	31
		Community	4.1	75	2	3	12	28	30	2.7%	4.0%	16.0%	37.3%	40
3	Small-acreage management of crop/livestock, natural & horticultural resources—esp. on tracts 35 acres or less	Family	3.0	74	17	10	17	18	12	23.0%	13.5%	23.0%	24.3%	16
		Community	3.8	75	4	9	9	28	25	5.3%	12.0%	12.0%	37.3%	33
4	Population pressure on agricultural lands, natural resources & communities; land use planning/management	Family	4.1	75	2	6	10	19	38	2.7%	8.0%	13.3%	25.3%	50
		Community	4.3	76	2	2	8	20	44	2.6%	2.6%	10.5%	26.3%	57
5	Public lands; human-wildlife conflicts; grazing permits; weeds; use restrictions	Family	3.7	74	3	7	21	22	21	4.1%	9.5%	28.4%	29.7%	28
		Community	4.0	77	2	3	18	27	27	2.6%	3.9%	23.4%	35.1%	35
6	Livestock production--management systems; marketing.	Family	3.5	74	10	10	9	22	23	13.5%	13.5%	12.2%	29.7%	31
		Community	3.8	77	4	6	17	25	25	5.2%	7.8%	22.1%	32.5%	32
7	Livestock waste management; odor; water quality	Family	3.3	75	9	12	22	13	19	12.0%	16.0%	29.3%	17.3%	25
		Community	3.9	76	4	4	15	26	27	5.3%	5.3%	19.7%	34.2%	35
8	Crop production--management systems, marketing, profitability	Family	3.8	72	8	7	6	23	28	11.1%	9.7%	8.3%	31.9%	38
		Community	4.1	73	3	3	9	25	33	4.1%	4.1%	12.3%	34.2%	45

9	Environmental concerns with ag chemicals & fertilizers; municipal and industrial wastes on ag	Family		3.6	75	5	8	20	18	24	6.7%	10.7%	26.7%	24.0%	32
		Community		4.1	76	1	3	17	23	32	1.3%	3.9%	22.4%	30.3%	42
10	Private land management issues--weeds, grazing; riparian areas	Family		3.5	74	7	9	20	19	19	9.5%	12.2%	27.0%	25.7%	25
		Community		3.8	77	3	7	20	22	25	3.9%	9.1%	26.0%	28.6%	32
11	Green industry-nurseries, parks, golf courses, turf, horticulture	Family		3.0	73	12	14	21	16	10	16.4%	19.2%	28.8%	21.9%	13
		Community		3.4	75	7	8	21	25	14	9.3%	10.7%	28.0%	33.3%	18
12	Water resources-quantity and quality, salinity, contamination	Family		4.5	74	1	4	5	13	51	1.4%	5.4%	6.8%	17.6%	68
		Community		4.6	77	1	1	5	17	53	1.3%	1.3%	6.5%	22.1%	68
13	Endangered species; impact on ag production/land use	Family		3.3	73	11	10	20	11	21	15.1%	13.7%	27.4%	15.1%	28
		Community		3.6	76	6	12	19	11	28	7.9%	15.8%	25.0%	14.5%	36
14	Alternative enterprises for farms & ranches; hunting; B & B; other recreation; aquaculture	Family		3.1	74	9	12	26	17	10	12.2%	16.2%	35.1%	23.0%	13
		Community		3.4	77	6	9	20	30	12	7.8%	11.7%	26.0%	39.0%	15
15	Adequate jobs, income; economic diversification; workforce preparation	Family		3.7	76	1	5	22	38	10	1.3%	6.6%	28.9%	50.0%	13
		Community		4.1	77	0	3	13	31	30	0.0%	3.9%	16.9%	40.3%	39
16	Adequate local revenue for public services, facilities	Family		3.6	76	4	9	24	19	20	5.3%	11.8%	31.6%	25.0%	26
		Community		3.9	76	1	9	17	21	28	1.3%	11.8%	22.4%	27.6%	36
17	Balancing of public-private rights/responsibilities, zoning and land use	Family		3.9	76	1	6	17	24	28	1.3%	7.9%	22.4%	31.6%	36
		Community		4.1	77	1	6	14	22	34	1.3%	7.8%	18.2%	28.6%	44
18	Access to reliable information via computer, e.g., internet	Family		3.8	75	2	10	10	30	23	2.7%	13.3%	13.3%	40.0%	30

	internet															
		Community		3.9	76	1	7	13	35	20	1.3%	9.2%	17.1%	46.1%	26	
19	Telecommunications availability in rural areas; business and education uses	Family		3.6	74	3	14	12	22	23	4.1%	18.9%	16.2%	29.7%	31	
		Community		4.1	76	1	6	8	32	29	1.3%	7.9%	10.5%	42.1%	38	
20	Ability of citizens to work together to solve mutual problems	Family		4.1	75	1	6	10	23	35	1.3%	8.0%	13.3%	30.7%	46	
		Community		4.3	77	1	1	11	23	41	1.3%	1.3%	14.3%	29.9%	53	
21	Anger management; violence prevention in public and private settings	Family		3.1	74	9	11	26	16	12	12.2%	14.9%	35.1%	21.6%	16	
		Community		3.8	75	3	7	19	21	25	4.0%	9.3%	25.3%	28.0%	33	
22	Family relationships, parenting skills	Family		3.2	74	11	14	20	8	21	14.9%	18.9%	27.0%	10.8%	28	
		Community		4.0	74	1	6	16	20	31	1.4%	8.1%	21.6%	27.0%	41	
23	Informed consumers, family financial management	Family		3.3	74	8	14	19	17	16	10.8%	18.9%	25.7%	23.0%	21	
		Community		3.8	76	0	10	19	25	22	0.0%	13.2%	25.0%	32.9%	28	
24	Food safety, healthy diets, sound health practices	Family		3.7	74	4	10	16	17	27	5.4%	13.5%	21.6%	23.0%	36	
		Community		4.0	76	0	7	17	21	31	0.0%	9.2%	22.4%	27.6%	40	
25	Youth character-building & life-skills; preparation for family, student, work, and civic roles/responsibilities	Family		3.6	75	6	9	19	17	24	8.0%	12.0%	25.3%	22.7%	32	
		Community		4.3	77	0	4	11	19	43	0.0%	5.2%	14.3%	24.7%	55	
26	Adequate/affordable housing & health care	Family		3.3	75	9	14	19	9	24	12.0%	18.7%	25.3%	12.0%	32	
		Community		3.9	77	0	8	21	15	33	0.0%	10.4%	27.3%	19.5%	42	
27	Income disparity, welfare reform	Family		2.9	74	14	17	17	12	14	18.9%	23.0%	23.0%	16.2%	18	
		Community		3.6	77	3	10	22	23	19	3.9%	13.0%	28.6%	29.9%	24	
28	Dependent care; children and elderly	Family		3.1	74	9	17	21	10	17	12.2%	23.0%	28.4%	13.5%	23	
		Community		3.8	77	1	8	21	24	23	1.3%	10.4%	27.3%	31.2%	29	

E. Multistate Extension Activities

The Dry Bean Research Program at Colorado State University participated in the annual evaluation of national and regional bean nurseries for yield, adaptation, and reaction to diseases. In addition to evaluation of bean cultivars, the breeding program develops commercial cultivars in the pinto and black bean market classes for use in the western US and High Plains. Cultivars are developed that possess stable resistance to rust, common blight and root rot. The breeding program released a new black bean cultivar 'Shiny Crow' that possesses shiny seed coat luster. It is the first such released in the US. Enhancement of disease forecasting programs reduced the number of fungicide applications (by 1 to 2 sprays), grower costs (by \$ 25 to 50 / Acre) and environmental exposure (by 10 to 20 % less pesticide) for producers. Participant states included *CA, FL, GA, ID, MI, NE, NYC, ND, OR, PR, WA, WI, in addition to Colorado.*

The Colorado corn bioeconomic modeling project aims to develop a robust version is available for making weed management decisions in irrigated corn. At this point the General Weed Model (GWM) has been developed which is a stand-alone software program written in Visual Basic. Much of the weed-corn competition data generated by the regional NC-202 project has been used to parameterize competitive interactions in the model as described by equations. The model has been tested with 50 corn producers with very favorable results; it reduced herbicide use by 16% and increased gross margin by \$11.60/acre compared to the growers' practices. Participant states included *IN, IL, IA, KS, MI, MN, MO, MT, NE, ND, OH, SD, TX, in addition to Colorado.*

Colorado investigators focused on changing gender roles in dual earner families. One of the most important findings challenged gender stereotypes in the area of expressive and instrumental family support. Men and women were most satisfied with their marital relationships when emotion work was balanced (both members of the couple performed at similar levels). This finding suggests that interventions aimed to balance emotion work in families promotes joint responsibility for the viability of the relationship. Thus, therapists should work with couples having difficulty to establish a "quid pro quo for the expression of caring." The results of this project have resulted in a reconceptualization of domestic labor, incorporating previously "invisible" aspects of family work and reflecting modern life. *Participants states included CA, ID, NM, OR, UT, WA, NON-SAES: PEI (Canada), IU (PA), in addition to Colorado.*

U.S. Department of Agriculture
Cooperative State Research, Education, and Extension Service
Supplement to the Annual Report of Accomplishments and Results
Integrated Research and Extension Activities
Five Year Fiscal Plan Summary

Institution Agricultural Experiment Station
 State Colorado

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

Name of Planned Program/Activity	Actual Expenditures				
	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004
Plant and animal improvement and new agricultural development.	\$266,695	\$274,696	\$330,514	\$330,514	\$330,514
Plant and animal production systems	\$53,358	\$54,959	\$66,126	\$66,126	\$66,126
Prevention and effective management of pests	\$68,759	\$70,822	\$85,213	\$85,213	\$85,213
Food Safety and Nutrition	\$88,657	\$91,317	\$109,872	\$109,872	\$109,872
Agriculture and environmental quality	\$46,625	\$48,024	\$ 57,782	\$57,782	\$57,782
Human and community development	\$398	\$410	\$493	\$493	\$493
Total	\$524,492	\$540,227	\$650,000	\$650,000	\$650,000

Director

Date

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