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# Agricultural Experiment Station

1991 Annual Report



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## Director's Report

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It is my privilege again this year to address you in the role of Interim Director. Throughout 1991, my responsibilities provided me with additional understandings of the complex and varied agricultural industry of this state. In the course of these lessons, I have become convinced that the industry's most valuable resources are the people who are the heart and soul of its many enterprises.

The vastness of this state is readily apparent as one travels to off-campus sites that are part of the Colorado Agricultural Experiment Station. Each of these sites provides a setting for environmentally specific studies important to the transfer of findings to producers. While the campus laboratories enable us to accomplish considerable work in response to producers' problems, field testing is an important facet in the research process and necessary for verifying the soundness and practicability of results. Brief summaries of the work at the various research centers are provided in this report.

The Colorado Agricultural Experiment Station plays a major role in program reviews within the University, with the support of the Cooperative State Research Service (CSRS) -- the USDA liaison agency to state agricultural experiment stations. Such reviews occur every five to ten years for colleges or departments and are important to ensuring appropriate focus to our endeavors. At the request of this office, and with special support from Cooperative Extension, CSRS led a comprehensive review in 1991 of the programs of the Department of Entomology, encompassing resident instruction, research and outreach. After a department self evaluation, six reviewers from outside the University visited the campus to interact with faculty, students and administrators. Recommendations by the site team will guide future entomology program adjustments.

A special review was sponsored by the Station during the year when, in cooperation

with the College of Agricultural Sciences and the Department of Plant Pathology and Weed Science, the operations of the Colorado Seed Laboratory were reviewed. External reviewers from the seed industry, the Colorado Department of Agriculture, and the National Seed Storage Laboratory (USDA/ARS) assisted University faculty and administrators in an assessment of the role and operations of the laboratory in relation to seed testing and seed science.

Through efforts of the Vice President for Research, Judson M. Harper, and the state's delegation to Congress, with considerable support from farm and commodity groups, Colorado State University received a special federal grant to augment state-funded studies related to control of the Russian wheat aphid. This is the first time Colorado agricultural research has benefited from ear-marked federal funds.

A major capital project of the experiment station over the past few years has been the North Agricultural Campus, an endeavor resulting from urban growth into the area near Fort Collins used for plant and animal research. Some \$600,000 had been appropriated earlier for land preparation, the irrigation system and additional planning. A second appropriation of \$2.2 million was made available in the 1991-92 fiscal year for the second phase of the project.

Dr. Frank P. Johnson, Assistant Director, has provided yeoman service as coordinator of the project and has worked closely with Dr. Lee Sommers, Head of Agronomy, and faculty representatives from each of the departments that expect to conduct research at the site. Numerous hours have been spent in communications with both the scientists and project architects and engineers to provide the highly detailed guidance necessary for a functional facility. Bids have been received and work may commence as early as mid March, with completion expected in the fall.

In the course of the year, additional progress was made on the strategic plan for the Station. The draft plan now awaits input from the Associate Academic Vice President who will arrive momentarily. This unit's plan must be integrated with that for the University.

Numerous times during 1991 we met with advisory committees for our research centers around the state, attended field days, spoke with cooperating farmers and ranchers, participated in meetings of various farm and commodity groups. These interactions have made us aware of situations existing in rural Colorado and challenges on the horizon for agriculture in this state. This information is taken into account as we guide program development efforts and as we prepare budget requests to present to the General Assembly.

As I reflect on these past months, my appreciation is deepened for all who contribute to the work of the Colorado Agricultural Experiment Station: scientists and support staff in twenty some departments and seven colleges on campus; all those at

off-campus locations; and the excellent staff here in the Director's Office. A number of farmers and ranchers cooperate with research scientists on specific studies and contribute in special ways. Those who serve on advisory committees give advice and counsel that sharpen the focus of our programs. The support provided by various commodity groups serves to augment the work of given scientists and/or projects. All of these factors have enhanced our research productivity which is described in this report.

A number of topics worthy of investigation are beyond the limits of current resources; yet, we continue to pursue alternative funding sources in the hope of responding to these needs. Our project portfolio is reviewed annually. We are pleased to share these summaries with you.

Helen F. McHugh  
Interim Director

## Research Summaries

### Food Safety Institute

On April 29, 1991, Governor Roy Romer signed an Executive Order creating the Colorado Task Force on Food Safety. The Executive Order asked the Task Force to make recommendations to the Governor and General Assembly on matters concerning the wholesomeness, quality, and overall safety of food products grown or consumed in Colorado. The Task Force was also requested to develop a state response plan for any future food safety crises and to report to the Governor on "how the state of Colorado can best provide assurances to its citizens that the food they consume meets the highest standards of safety and wholesomeness".

Task Force members named by the Governor included Pat Kendall, a food safety expert from Colorado State University, three producers, one person each representing the food processing and food marketing industries, two representatives of the general public, and two members of the Colorado General Assembly. Task Force members met six times in day-long sessions from June through November, 1991.

In their November 20, 1991, report to the Governor, the Task Force recommended the creation of a Colorado Food Safety Institute to operate as the focal point for food research and information related to food safety concerns. The Institute, to be housed at Colorado State University, would build on the expertise of researchers with the Agricultural Experiment Station and educators with Cooperative Extension that specialize in food production, processing and handling practices to reduce incidence of contamination.

The Task Force recommended that the Institute be developed around a statewide coalition with representation from the food industry, industry trade organizations, regulatory agencies, consumers, and the media. The Institute would consist of three main components: 1) basic and applied

research, 2) educational outreach, and 3) technical assistance in food product development, processing and marketing via the existing Food Research and Development Center (FRDC).

The Governor accepted the Task Force's recommendations and has extended the original Executive Order for the Task Force through June 30, 1992, with the specific responsibilities of 1) advancing the recommendations made in the original report, and 2) assisting in determining potential funding sources for the development and implementation of a Food Safety Institute to be based at Colorado State University.

### Molecular Genetics and Cattle Improvement

The technique of "DNA fingerprinting" has been used in human medicine and law since the mid-1980s to determine paternity, criminal guilt and to diagnose genetic diseases such as cystic fibrosis and hemophilia. This method involves collecting a blood or semen sample as a source of DNA (the natural chemical responsible for genetic inheritance-present in all cells of the body). After the DNA is extracted from the sample, it is cut into small pieces with specific enzymes and then separated according to size by a process known as electrophoresis. After this step, specific genes can be identified using DNA "probes," which are mirror images of the naturally occurring genes. Just as an individual's fingerprints are unique, so is his genetic makeup. The DNA "fingerprint" allows us to literally see an individual's genetic makeup and to compare it to his siblings, parents or unrelated individuals with similar (or dissimilar) characteristics. Thus, this is a powerful tool to positively identify individuals and provides a number of practical applications.

In law, persons suspected of violent crimes can be identified by their DNA fingerprint if blood (or semen) from the scene of the crime



is analyzed and compared to the suspect's DNA fingerprint. Likewise, a blood sample from a suspected father (or sire) can be matched to progeny in order to prove paternity. In livestock operations this can be used to identify sires responsible for progeny which display superior growth, milk production, carcass characteristics or other economically important traits. In open breeding systems, DNA fingerprinting can show which of several potential sires is responsible for the majority of progeny, again aiding in the selection process, as sires with low service capacity can be identified and removed from service.

Of interest to purebred ranchers is the potential to positively identify animals of specific breeds. DNA fingerprinting will prove that a purebred animal is pure and that no "stray genes" from other breeds are present. This will bolster breed associations and will lead to a rapid elimination of contaminated, crossbred animals. Remember that DNA fingerprinting can be applied to semen as well as blood, so that semen stock from a long-dead animal can be tested for specific qualities and eliminated if necessary. Although not common, paternity suits in cattle have been brought to court. When the neighbor's Hereford bull gets into your purebred Simmental herd and inseminates a number of cows, DNA fingerprints will identify which calves resulted from the illicit union. This may be used as evidence in a damage suit as well as to remove those calves from the purebred herd.

All of these applications are relatively straightforward and involve existing technology. In the near future, the entire genetic component of cattle will be mapped. That is, the location of each gene which determines the heritable makeup of cattle will be known. Again, we will be able to visualize the genetic makeup of cattle and to base selection of economically important animals on the presence or absence of particular genes.

The techniques of molecular biology are a logical extension of current biological concepts. Scientists have known that genes

and DNA are responsible for inheritance since Watson and Crick's discovery of the structure of DNA in 1954. Only within the last few years have we had the capability to easily construct fragments of DNA and genes. The application of this basic biological knowledge to real-world problems provides the means to solve problems ranging from disease identification to gene repair to vaccine production. DNA fingerprinting is a powerful technique which will allow livestock producers to easily and effectively identify animals for a variety of uses and applications. DNA fingerprinting will allow the producer to take advantage of a new, powerful technique that has the potential to rapidly improve livestock. The rancher of the future will select animals not on how they look, but on how the animal's genes look.

### **Animal Biotechnology**

Ongoing research projects in three general areas use biotechnology procedures to: 1) enhance reproductive performance; 2) genetically engineer disease resistance; and 3) improve methods for rapid and reliable diagnosis of infectious diseases.

**Reproductive Performance:** Methods have been improved for maturation and fertilization of oocytes in vitro and up to 200 bovine embryos have been produced per week from ova isolated from slaughterhouse ovaries. This research is key for production of the large number of embryos required in transgenic research. Molecular biological procedures are also being used to determine the physiologic basis for seasonal, prepubertal and postpartum anestrus in sheep and cattle. Finally, methods to enhance production of viable, freezable sperm and to reduce the 15 to 50% early embryonic wastage which occurs in farm animals continue to be a major research focus.

**Disease Resistance:** Research is aimed at producing chickens which are genetically resistant to Newcastle's Disease virus and cattle which are genetically resistant to selected viral diseases. In addition, transgenic mosquitos have been produced which cannot

spread specific viral diseases when feeding on domestic animals. The ultimate goal of this research is to produce more efficient strains of domestic livestock which require fewer drugs.

**Disease Diagnosis:** A long-term research program reproduces diagnostic reagents for infectious diseases which are rapid, reliable and inexpensive. Major recent breakthroughs have been reliable tests for the agents which cause bovine viral diarrhea and tuberculosis. The influx of tuberculous-infected cattle from Mexico to Colorado has made this disease a real problem. We have produced reagents used in this country and the European Economic Community to detect cattle infected with this disease.

### **Plant Biotechnology Laboratory**

The Plant Biotechnology laboratory represents a recent development at Colorado State University, and was designated by the University as a Strategic and Emerging Program of Excellence in 1991. A major portion of funds for development of a laboratory facility came from the Provost/Academic Vice President, Vice President for Research, and the Colorado Agricultural Experiment Station. The College of Agricultural Sciences has committed significant research dollars to base funding for laboratory personnel.

The College of Agricultural Sciences and the Colorado Agricultural Experiment Station developed a plan for plant biotechnology in 1986. The plan called for a Plant Biotechnology facility and for faculty to be hired with specialization in fields related to plant biotechnology. The College and the Agricultural Experiment Station established the goal of an integrated research program encompassing several departments of the College. This planning phase was followed by the hiring of Dr. Dennis L. Knudson in Entomology (1988), Dr. Nora Lapitan in Agronomy (1989), Dr. Carol Ishimaru in Plant Pathology and Weed Science (1989), and Dr. Cecil Stushnoff in Horticulture (1990). These faculty joined Dr. P. Elaine Roberts (Entomology) and Dr. Rajinder S.

Ranu (Plant Pathology/Weed Science) as the core faculty in the College of Agricultural Sciences' plant biotechnology initiative.

In January 1990, the Plant Biotechnology program was established under the name of the Plant Biotechnology Laboratory, which has become a synonym for the program. Dr. Dennis L. Knudson was named Director of the Plant Biotechnology Laboratory. Since there were also faculty in the College of Natural Sciences with strong commitments to plant molecular biology, the Plant Biotechnology Laboratory was established as an inter-college program.

The overall objective of the program is to utilize the tools and techniques of plant biotechnology to enhance the sustainability of agricultural production systems. The program focuses resources on improving resistance or tolerance of economically important plants to stress resulting from pests, predation, drought, salinity, heat, frost, or other environmental factors. The faculty expertise is directed in 3 areas of concentration: plant improvement, biological control, and interdisciplinary approaches among the first two areas.

The Plant Biotechnology Laboratory is a centralized laboratory, which is housed in the Plant Sciences building, and represents a shared facility dedicated to providing state of the art equipment and quality research space to faculty and students. The laboratory's activities are augmented through external contract and grant funds generated through research projects by participating faculty.

### **Russian Wheat Aphid Wheat Breeding Research**

Colorado State University released a Russian wheat aphid-resistant strain of hard red winter wheat, CORWA1, for use by regional wheat-breeding programs. CORWA1 was derived from crosses to a Russian wheat which was discovered as resistant in 1987.

This resistance was confirmed in 1989; however, this T-57 wheat essentially has none of the other qualities needed by our

producers. The only redeeming characteristic of T-57 is its resistance to the Russian wheat aphid (RWA). It is a soft white wheat that has long, weak straw, matures late, and is susceptible to disease.

The challenge to the Colorado State wheat breeding program was to take the aphid resistance of T-57 and combine it with a high quality, high-yielding hard red winter wheat.

It normally takes at least ten years to develop a new wheat variety. The breeding program was speeded up by growing the first four generations of plants in the greenhouse, using a growth chamber to vernalize them and using a supply of artificially-raised aphids to evaluate RWA resistance of each new generation of plants.

After the first four generations, 800 lines were selected for RWA resistance, red grain color, hard kernels, short height and early maturity. Seed from these lines was increased in the summer greenhouse in 1990 and evaluated in field test plots in 1990-1991 for RWA resistance and such characteristics as yield, quality, maturity, height, lodging, shattering, resistance to wheat streak mosaic virus and winter hardiness.

Of these 800 lines, 112 are adapted, aphid-resistant hard red winter wheats with the characteristics required for milling and baking. One is CORWA1, and if all goes well, researchers should be able to identify the best line and release a new RWA-resistant wheat variety in 1994. A commercially viable hard red winter wheat that is RWA resistant will benefit both producers and consumers. It will reduce production costs and the amount of chemicals released into the environment.

Resistance to the Russian wheat aphid has been transferred from triticale to wheat lines by backcrossing. Low crossability, low viability of F1 embryos, and high sterility in early generations were restrictive factors during introgression. Chromosome 3R was found at the highest frequency among resistant substitution lines. Allelism studies indicate that at least 5 major resistance genes are present in wheats.

The wheat breeding program is supported with funds from a special Russian wheat aphid initiative by the Colorado General Assembly to the Agricultural Experiment Station and with funds from the Colorado Wheat Administrative Committee.

## Notes from CAES Research Centers

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### Arkansas Valley Research Center - Rocky Ford

Research at the Arkansas Valley Research Center in 1991 was on field and vegetable crops and covered the areas of conservation tillage, cultural practices, irrigation, variety trials and pest management.

Monitoring of three irrigation canals in the area showed reduced amounts of nitrogen in the water compared to previous years. However, tests applying additional nitrogen did not significantly increase alfalfa yields. The 3 year nitrogen/irrigation study on onions was brought to a conclusion showing that nitrates can leach well below the root zone and irrigation can aggravate this process. Irrigation scheduling programs can alleviate the problem. Tests in corn resulted in fewer irrigations using a scheduling program while maintaining yields.

Yields in no-till corn continue to approximate that of corn grown under standard tillage methods but crop residues are a major problem for growers who use furrow irrigation and cultivation. Date of planting tests for three years show that spring grain (wheat, barley, oats) yields will generally increase with earlier planting dates. Planting after April 1 risks reduced yields.

Pest management research included a simulated storm damage study on onions to determine the effect on disease response and yields. Onions thrips continue to have resistance to registered insecticides and a trial was initiated to determine the tolerances of various onion types to this pest. Indications are that carbofuran does adversely affect the stem nematode in alfalfa. Two years data show Banks grass mite populations and its predators are not affected by planting time or lay-by applications of granular insecticides for other pests. The new greenbug biotype, designated "I", for which there is little known resistance has been identified in southeast Colorado. Work will be increased in this area

next year. Available herbicides combined with good cultural practices, can provide adequate weed control in alfalfa, beans and onions.

Variety trials were carried out in the following crops: alfalfa, beans, corn, sorghum, onions and winter wheat. A few "alternate" crops were tested.

The addition of a vegetable crop scientist has allowed us to substantially increase the research necessary to meet the needs of this industry.

### Eastern Colorado Research Center - Akron

The Eastern Colorado Research Center just completed work on a new cattle working facilities designed to: 1) strengthen our capabilities for conducting research as to the effects of various cattle handling procedures, behavior, and stress, and 2) provide a unit that will allow us to handle the cattle numbers and research needs for the nutrition and reproduction studies conducted at Eastern Colorado Research Center.

The field day was held on May 21, 1991. Papers presented included the results of trials completed at the Research Center the past year. These papers were:

- The Influence of Roughage Sources in Whole Shelled Corn Diets in Finishing Steer Performance and Carcass Characteristics
- The Effect of Self Feeders or Concrete Fenceline Bunks on Finishing Steer Performance
- The Effect of Increasing Energy in Combination With MGA-PGF2 Synchronization Program in Post-partum Cows

- The Effects of Different Protein Supplements on the Performance of Gestating and Lactating Cows on Dormant Winter Pasture in Northeast Colorado.

Reports on these trials are in the 1991 Beef Program Report which is available from the Department of Animal Sciences. Guest speakers also spoke on nitrate toxicity in beef cattle, effect of source and level of copper in growing steers and managing weak newborn calves.

Research currently being conducted at Eastern Colorado Research Center:

- Efficacy evaluation of erodible norgestomet implants
- The effect of increased lipid content in the diet of gestating and lactating heifers on reproductive efficiency
- Nitrate toxicity in cattle
- The effect of a second dose of PGF2 in an MGA,PGF2 synchronization system in mature cows
- The effect of roughage level in whole shelled corn rations upon finishing steer performance and carcass characteristics
- The effect of potassium level on wintering cow performance

**Fruita Research Center - Grand Junction**

Annual cultivar performance tests were conducted during 1991 in small grain (winter and spring wheat, barley, oat, and triticale), corn grain and forage, alfalfa, dry bean, and soybean. Off-station sites included corn plots at Delta and Olathe, and dryland wheat trials at Meeker and Hayden.

In cooperation with Randy Ristau from Cooperative Extension in Montrose, we evaluated alternate dry bean material to determine the potential for producing new dry bean seed types in Colorado. Diversifying the state's traditional pinto bean production to include other desirable seed color types of dry bean may increase profits by attracting more

business into Colorado and by capturing higher prices for specialty dry beans than those currently paid for pintos.

Two irrigation studies were conducted during the year at the Research Center. Throughout the growing season, Research Center staff worked with SCS and Cooperative Extension personnel monitoring the performance of surge irrigation in a furrow-irrigated field of corn at the Center. Results of a preliminary study indicate that less water is required to germinate seed planted closer to the irrigation furrow than seed planted in the middle of the bed.

Production of corn, dry bean, winter barley, and soybean was successfully achieved using conservation tillage in a furrow-irrigated cropping system. Residue in the furrow did not cause significant problems during irrigations. Much of the success of conservation tillage in our furrow-irrigated cropping system is attributed to forming the ridges in the fall of each year.

Harvest of nineteen varieties of asparagus for the third consecutive year was overseen by Curtis Swift of Tri-River Area Cooperative Extension. Yield and quality of the product were lowered because of freezing temperatures during the harvest period.

The potential for sorghum seed production in western Colorado has been studied since 1989. The research was conducted cooperatively with Dr. Paul Nordquist, a plant breeder from the University of Nebraska. We have found that high quality, genetically pure sorghum seed can be produced in western Colorado. These findings are based on the results obtained from sorghum grown in small plots. In 1992, we plan to produce a small commercial acreage of sorghum seed near Loma, Colorado.

Russian wheat aphid (RWA) research concentrated on environmental effects on overwintering aphids. Complete winter kill of RWA on the western slope of Colorado was due to extended below freezing temperatures during January and February. Western

Colorado was reinfested in May, and by fall, populations were at their highest level since 1986. Current projects include economic impact of fall RWA populations, alternate host plant studies, evaluation of planting time insecticides, and modification of irrigation bedding to decrease the overwintering success of RWA.

Additional studies in 1991 were conducted on the efficacy of several herbicides in alfalfa; nitrogen use efficiency of several nitrogen fertilizers in corn; corn yield responses to residual manure applications; application of fluid and dry nitrogen fertilizers in corn at approximately the tenth leaf stage of growth; and sweet corn earworm control in cooperation with Gene Nelson, entomologist from the Tri-River Area Cooperative Extension office.

Activities of the Dry Bean Foundation Seed Project during 1991 included our routine operations for foundation seed production. Seed was increased for 59 dry bean varieties and lines. Thirty-one lines were from the dry bean breeding program. Fourteen lines were material termed "white mold differentials" for use in Dr. Howard Schwartz's research program. Ten increases were from the dry bean breeding program at North Dakota State University.

Research and demonstration plans for 1992 will include evaluating winter wheat (hard red and triticale) and Austrian winter pea mixtures for hay production, minimum till planting in furrow-irrigated corn and alfalfa residue, effect of planting date on corn development, effect of seed row placement in relation to the irrigation furrow on seed germination, early spring planting of durum wheat, split applications of fluid N fertilizers using surge irrigation, field evaluation of alfalfa germplasm for alfalfa stem nematode resistance, and direct combining of double-cropped, no-till planted pinto bean into standing small grain stubble.

## **Mountain Meadow Research Center - Gunnison**

Major accomplishments in 1991. Organized and presented The Third Intermountain Meadow Symposium at Steamboat Springs, CO in cooperation with the University of Wyoming. There were thirty presentations by authors from ten states, Washington, D.C. and Canada. The proceedings contained twenty-eight reports in 254 pages.

Nine-year research on weedy wild caraway documented clover cycling, orchardgrass winterkill and regrowth, dominance and persistence of dandelion, the deleterious effects of nitrogen fertilization upon clover cycling, but its beneficial effects upon grass growth and reduction in caraway dominance, the benefits of phosphorus for clover growth and its deleterious effect in promoting caraway growth. The efficacy of sod-seeding without herbicide usage as an environmentally-safe method of introducing legumes and grasses into native meadows was further confirmed. Nitrogen stimulation of smooth brome grass yields was shown to be due to promotion of flowering. Sod-seeded alfalfa benefitted from phosphorus fertilization, but it was hurt by nitrogen. Exploratory studies of low and tall larkspur found small underground storage organs for low larkspur, and large rhizomatous-like organs for tall larkspur. Tall larkspur flowered two weeks later than low larkspur, and the degree and timing of development was temperature and moisture sensitive; warmth promoted earlier growth, and "drought" limited plant size.

Research thrust for 1992. Conclude the caraway-nitrogen only research. Conclude the study of the yield and longevity of timothy varieties. Conclude the thirty-variety test of alfalfa and miscellaneous legumes, obtaining yield and longevity data. Continue analyses of the effects of nitrogen and phosphorus upon sod-seeded alfalfa. Determine second-year effects of heavy applications of ammonium sulfate to stands of low and tall larkspur. Revisit experimental and demonstrational sod-seedings to determine what management

conditions contribute to success and failure. Prepare a summary-type mountain meadow bulletin - compiling significant research findings from 41 years, and emphasizing relevance to 1992 conditions.

### **Orchard Mesa Research Center - Grand Junction**

The major new program this year was on wine grapes. The Colorado Wine Industry Development Board, created by the Colorado legislature in 1990, funded a new research position for viticulture and enology. Facilities developed included a lab and instrumentation for vine cold hardiness research, an enology lab, a field capability for extensive soil moisture monitoring in most Colorado vineyards, trellis materials, vines and a versatile drip irrigation system for a new research vineyard. Technical assistance to established and prospective growers and vintners was provided upon request.

Tree crop research included pear insect management, apple codling moth control for home orchards, peach vigor control through root restriction, variety and rootstock testing, drought stress physiology, peach mosaic and MLO diseases, orchard replant problems, elk and deer repellents, and peach rusty spot control.

Entomology research evaluated the use of an oil-supplemented spray program (+OIL) on pears for the third season; it reduced the use of Thiodan (for mealy bug control) and other miticides. The +OIL program provided better control of spider mites and pear psylla (postharvest psylla counts were only 25% those in the standard program) and comparable control of mealy bug, pear rust mite, and codling moth. Foliage was temporarily stressed by the oil program, but the +OIL program reduced fruit size only slightly compared to the standard program. Shoot growth in the +OIL program trees was markedly better than those in the standard program.

Peach vigor control studies found that the root volume needs to be severely restricted in

order to get tree size control by the third or fourth season. The spunbond polyester fabric also may be less than a perfect barrier to tree roots. Controlling growth with regulated deficit irrigation through drip emitters appears more promising. The variety trials in progress include 51 peach varieties, 12 apricots, 10 pears, 17 pear rootstocks, 4 new apples, and 20 grapes. Drought stress physiology of Asian pears was researched in New Zealand. The response of trees grown in lysimeters was characterized in terms of water use, sap flow velocity, leaf water potential, stomatal behavior, shoot growth, and fruit quality factors.

Peach mosaic (PM) research found suspected PM infections in two Mesa County orchards, the first probable cases since 1984; other PM studies demonstrated PM symptom expression in one nectarine and three peach cultivars. Mycoplasma (MLO) disease studies documented the reliability of DAPI fluorescence microscopy for MLO detection and the presence of MLO's in "grapevine yellows" symptomatic grape tissue samples from NY; incidence of X-disease MLO detected by DAPI, in western Colorado orchards remained very low in 1991. Preplant backhoeing and soil fumigation continued to enhance early tree growth for peach and apricot; fall preplant fumigation provided better first season growth than did backhoeing for peach and cherry planted in old cherry orchard soil. Two elk and deer repellents were evaluated for phytotoxicity; no tree damage from summer applications of these materials was observed, even though the Hotsauce was applied at 100X and 200X the labeled rates. Incidence of peach rusty spot on susceptible peach fruit was extremely low because of low disease carryover into 1991; three postbloom applications of Nova did not reduce disease incidence in 1991 as they had in 1990.

### **Plainsman Research Center - Walsh**

Winter wheat and grain sorghum continue as the two main research crops at the Plainsman Research Center. In cooperation with the Russian Wheat Aphid Project and the Crop Testing Program, we are studying the impact

on RWA infestation by: grazing, planting date, row spacing, and insecticides. Also in association with the Crop Testing Program winter wheat variety trials are conducted under dryland and irrigated conditions, as well as a dryland N and P fertilization study. In response to grower requests for larger test plots, we have reinstated our wheat strip variety trial. Each replicated varietal strip covers approximately half an acre.

The sites for the Colorado Grain Sorghum Performance Test have been expanded into the major grain sorghum production areas in Southeastern Colorado. There are now six grain sorghum test sites: an irrigated site and a dryland site at Walsh; two dryland sites at Vilas, one under a wheat-sorghum-fallow rotation, the other under continuous sorghum production; an irrigated site at Holly; and a dryland site at Eads.

Placement and rate of P fertilization was tested on grain sorghum. Four placement methods were used: broadcast, sidedress, dribble, and with the seed. The three P rates were the soil test recommendation, half the recommended amount, and one-quarter of the recommended amount.

A new area of emphasis at the Plainsman Research Center is irrigation efficiency. The two major studies currently under assessment are limited furrow irrigation and center pivot irrigation using Low Energy Precision Application (LEPA) drop nozzles. Under limited irrigation both grain sorghum and corn are given a single irrigation at flowering. Water use efficiency is greatly increased when an irrigation is applied near flowering. Fortunately, corn silking occurs about two to three weeks before grain sorghum flowering, which allows small production wells to irrigate more acres of feed grains at a critical reproductive stage, thereby increasing overall grain yield. Under the LEPA-equipped sprinkler early maturing corn hybrids were grown. In the LEPA 1 mode, water infiltration and movement may be problematic in the high part of the field if the crop is planted in the same direction as furrow irrigated, i.e., in the direction of water movement. Planting

perpendicular to the water movement may help rectify this problem. Corn yields this year for both limited and LEPA irrigations were lower than anticipated. This was due in part to inadequate winter and spring moisture. To circumvent this problem, it may be necessary to pre-irrigate to achieve at least a base yield from which to work.

Dryland corn was investigated as a potentially new rotational crop for Gary Peterson and Dwayne Westfall's Dryland Agroecosystems study near Walsh. Two planting dates and two seeding rates were tested. The yields from the later planting date and the lower seeding rate were encouraging enough to try corn next spring in the opportunity rotation.

Herbicide studies conducted by Plainsman personnel included broad-spectrum weed control in grain sorghum, shattercane control in corn, Western Whorl-leaf Milkweed control in wheat-fallow, and preplant-incorporated herbicides in sunflower.

Two alternative oil crops were studied: four varieties of flax from North Dakota and standard height and dwarf sunflowers.

The Plainsman Research Center was proud to hold the first annual Plainsman Preschool Pumpkin Patch Party. It provided the opportunity for our staff to talk to the children about the importance of crops and crop research for our area, while directing a positive public light on the Center.

### **Rogers Mesa Research Center - Hotchkiss**

This year Dr. Alvan G. Gaus was appointed superintendent of the Rogers Mesa Research Center. Current research involves studies on production efficiencies of varying apple, peach, and sweet cherry varieties and rootstock combinations, high density plantings, varietal adaptation, and heat stress.

Several new plantings at Rogers Mesa Research Center were developed. A new high-density, systems trial which is to be planted in the spring of 1992 was started. A



multi-functional water delivery system was designed and partially implemented for this trial. The irrigation system incorporates both under and over tree sprinklers for frost protection, orchard cooling, fertigation, and deficit irrigation. In addition to the systems trial, a new apple variety trial was designed with virus-free scions and rootstocks from the USDA's IR-2 plant introduction program. This trial will evaluate recent varieties and selections from Japan and New Zealand.

The hyper-density, experimental planting of 'Golden Delicious' was expanded by 500 new trees. The irrigation system was changed from overhead sprinkler to gated pipe to avoid fire blight and distribute water more uniformly.

A novel method based on the reflective properties of cellulose fibers for reduction of heat stress disorders of apple fruit was researched. Cellulose fibers of 40 microns or shorter could be applied through conventional sprayers equipped with hydraulic nozzles; however, 100 micron fibers required specialized application equipment. A prototype sprayer independent of cellulose's physical properties was constructed based on the air shear nozzle principle. Research also focused on binding the cellulose fibers to the fruit. It was found that under orchard conditions the commercial binding agent Triton B-1956 (Rohm and Haas) allowed the cellulose fibers to be washed off by rain. For rainfall less than 1 cm, a solution of 1% amylopectin, solubilized in boiling water, combined with 0.01% Triton B-1956 proved to be an adequate binding agent.

Examination of the surface of 'Golden Delicious' apples, treated with cellulose fiber suspensions, revealed a substantial reduction in red color. The effect was most pronounced for the fruit with visible cellulose remaining at the harvest and for fruit directly exposed to sunlight some time during growing season. The surface color (hue) of fruits, determined from Munsell color charts, ranged from 10YR (yellow-red) without cellulose residues to 5Y (yellow) for surfaces with visible cellulose residues.

The sunburn preventive property of cellulose was difficult to evaluate in 1991 due to the relatively low incidence of sunburn and large variability among experimental plots. One cellulose treatment resulted in a greater than 20% reduction in sunburned fruit, which is a commercially significant amount.

### **San Juan Basin Research Center - Hesperus**

Primary research concerns continue to focus on composite crossbreeding of beef cattle. The objectives of this study are to select and mate composites with genetically diverse breeding but comparable biological type and form a new composite from the three initial composites. Additionally, the performance and amount of heterozygosity maintained in the composite crosses will be evaluated. There are two composite systems being evaluated. The first, System 1, consists of CASH, RX3 and MARC III composites crossed on Hereford cows. The second, System 2, comprises Brangus, Beefmaster and Barzona composites crossed on Angus and Red Angus cows. The progeny are then systematically crossed to obtain an individual that is one-quarter of each of the composite breeds plus one-quarter of the foundation dam breed within each system. Performance updates and results are published in the Annual Beef Cattle Report.

A cooperative study with Hoffmann - La Roche Inc. was conducted to evaluate the efficacy of erodible type norgestomet implants for increasing rate of weight gain and inhibiting cycling in non-pregnant growing heifers. The study began in May and ended in October. Weights and blood samples were taken on 98 crossbred heifers to measure weight gain and progesterone levels. Results of this study are currently being analyzed.

Replacement heifers are being evaluated under two different environments. Fifty-five heifers are to be fed for breeding under typical mountain conditions at the Research Center at an altitude of 7600 feet. Another group of fifty-five heifers will be fed under feedlot conditions at Farmington, New Mexico, at an

altitude of 5500 feet. Heifers fed at Hesperus will receive native hay plus grain. Those fed at the Navajo Agricultural Products Industry (NAPI) feed yard near Farmington will receive a vegetable ration consisting of potatoes, pumpkins, onions, corn silage and hay. Both groups will be evaluated for rate and cost of gain, reproductive performance and longevity.

Purebred and crossbred steers produced from the Research Center cow herd were fed at the NAPI feed yard. Both groups of yearlings gained 4.05 pounds per day during 1990.

Two-hundred-fifty young bulls representing 12 breeds and crosses from 40 ranches and 8 states were performance tested at the 4-Corners Bull Test Station.

One-hundred young rams from 26 Colorado breeders were performance tested at the Colorado Ram Test during 1990.

### **San Luis Valley Research Center - Center**

Potato Breeding Program. Thirty parental clones were intercrossed in 1991. Seeds from 64 combinations were obtained. Sixty seedling families were grown in the greenhouse producing 9,478 tubers for initial field selection in 1992. Surplus seedling tubers will be distributed to Idaho, Oregon, Texas, and Alberta, Canada.

Seedling tubers were obtained from Dr. J. J. Pavek, USDA-ARS, Aberdeen, Idaho; Dr. J. Creighton Miller, Texas A & M University, Lubbock, Texas; Dr. Dermot Lynch, Agriculture Canada, Lethbridge, Alberta; Dr. Robert Johansen, North Dakota State University, Fargo, North Dakota; and Dr. Kathleen Haynes, USDA-ARS, Beltsville, Maryland.

Potato Selection Program. A total of 80,300 first-year seedlings were planted, with 884 being selected for further observation. Another 1,032 clones were in various stages of preliminary and intermediate testing. Two hundred thirty six of these clones were saved

for further evaluation. Twenty-seven advanced selections were saved and will be increased.

Disease Evaluations. Twenty clones and four named cultivars were screened for symptom development to bacterial ring rot and leafroll. Disease symptoms in 1991 were adequate on all clones for leafroll expression and all but four of the clones for ring rot expression. All clones are tested at least two years. Adequate symptom expression to these two disease problems has been one of the critical factors considered prior to the release of any clone to the growers.

Grower Trials. Grower evaluations were conducted on four russets (AC78069-17, AC81198-11, CO80011-5, and CO81082-1) and one chipper (AC80545-1). Selection AC81198-11 was discarded from further testing. Growers recommended naming CO80011-5 and AC80545-1. Two additional selections, AC75430-1 and CO82142-4, will be released for initial commercial testing in 1992.

Cultivar Releases. CO80011-5 will be released by the Colorado Agricultural Experiment Station in late 1992 after another season of seed increase as a high yielding, medium-early maturing, fresh market potato. AC80545-1 clone was selected in Colorado and will be released in early 1992 jointly by the Colorado and Idaho Agricultural Experiment Stations and the USDA-ARS. AC80545-1 will be released as a chipping potato. Ranger Russet (A7411-2) was released in 1991 jointly by the Idaho, Washington, Oregon and Colorado Agricultural Experiment Stations and the USDA-ARS. Ranger Russet is medium-late maturing potato with processing and fresh market qualities.

The influence of single drop and cut seed on yield, grade, stand and stem number for Centennial Russet, Russet Burbank, Russet Norkotah, Russet Nugget, and Sangre was studied. There were no significant cultivar X seed type interactions. Planting cut seed

resulted in lower yields, increased stands, and fewer stems per plant.

The influence of hill size and nitrogen fertility on yield, grade, stand, and internal pink discoloration of tubers of Russet Nugget was evaluated. Nitrogen did not have a significant effect on any of the variables. Small hill size resulted in significantly lower total, US #1, and 283g tuber yields.

Thirty-two lots of potatoes representing six cultivars were evaluated for raw product processing quality. Specific gravity ranged from 1.072 for Russet Norkotah to 1.088 for Russet Nugget. Additional data on sugar content at various storage intervals is currently being collected.

One hundred thirty-one samples of potatoes were evaluated for one or more of the following postharvest characteristics: specific gravity, chip color, french fry color and texture, susceptibility to blackspot, enzymatic browning potential, storage weight loss, and dormancy. Results of these evaluations are incomplete at present.

Weeds in the San Luis Valley have been screened for the past three years for the presence of Potato Virus S. In many other areas, weeds have been found to be hosts for this virus. In addition, aphids were screened for their ability to transmit PVS from infected to healthy plants. In 1991, the number of weeds with PVS present was consistent with previous years' results. Preliminary indications are that certain species of weeds in the San Luis Valley may harbor the virus and might act as a reservoir for infection of healthy potatoes. Aphid transmission studies using local colonies of Green Peach Aphid resulted in no PVS transmission from infected to healthy potatoes.

The use of sulfuric acid as a potato vine desiccant has been increasing in recent years in the San Luis Valley. Studies are underway to examine the effectiveness of sulfuric acid to reduce or eliminate spread of Potato Virus X, *Erwinia* spp. and bacterial ring rot when vines are chopped prior to using the acid,

when the spray rigs move through the field and when potatoes are sprayed and then chopped. Preliminary results indicate that this type of desiccation is an effective method for eliminating spread of these above potato pathogens from one plant to the next.

### **Southeastern Colorado Research Center - Springfield**

A creep feeding study for beef calves was conducted with Farmland Industries Creep-gest creep feed in 1991. Suckling Gelvich and Limousin calves were supplemented ad libitum with Creep-gest feed from July 1 to weaning (September 28). Supplemented calves gained on average 0.31 pounds per day more than control calves. This added gain cost \$1.64 per pound. Stocker steers grazing summer pasture were supplemented with ground corn or ground corn with either a live or dead yeast product. Control steers had an average daily gain (ADG) of 1.88 pounds, whereas steers supplemented with ground corn had an ADG of 2.05 pounds. Steers supplemented with ground corn Plus a live yeast product had an ADG of 2.21 pounds and those with the dead yeast product 1.96 pounds.

From 1983 to 1991 yearling steers managed under a short duration rotation from mid-May to early October gained 0.19 pounds per day less than steers managed under continuous grazing. Steers stocked at a moderate rate gained an average of 0.62 and 0.75 pounds per day more than steers stocked at a heavy rate under short duration rotation and continuous grazing, respectively.

Five acre plots of forage sorghum-sudangrass hybrid varieties were evaluated for yield and quality in 1991. Golden Acres "Milkmaker" yielded 78, 348 and 739 pounds more dry forage than Buffalo Brand "Canex", Funks "Faster Pasture" and Triumph "Super Sile", respectively. Super Sile contained the highest percent crude protein content at 7.11 and Milkmaker the lowest at 4.84. Crude protein contents were low due to 0.33 inches of rain that fell after swathing and 1.25 inches that fell after baling. Digestible dry matter

contents ranged from 60.6% for Super Sile to 65.4% for Canex.

Sixteen and twelve cool and warm season grasses, respectively, were interseeded into four row plots in a go-back pasture in February 1991. Grasses that had better than a 20% stand based on ocular estimations in October 1981 were Rosana western wheatgrass, ascension 90523823 smooth brome grass, Paiute orchardgrass, and Haskell and El Reno sideoats grama. These plots will be evaluated again in 1992 and 1993 to determine which grasses will be used for an expanded interseeding study under grazing. The same sixteen cool season grasses interseeded into a go-back pasture where also seeded into four row plots in a forage sorghum stubble in February 1991. Eight of the grasses had better than a 20% stand in October 1991. Paiute orchardgrass and Siberian wheatgrass had better than a 50% stand. Results of this study along with past cool season grass studies will be used to determine which cool season grasses hold promise for extending the grazing season.

Plots in a go-back pasture established in April 1987 have been fertilized with nitrogen and phosphorus each April since. Species composition has shifted to more desirable grasses due to nitrogen fertilizer at 40 to 100 pounds per acre. Phosphorus fertilizer has had no effect on species composition.

### **Southwestern Colorado Research Center - Yellow Jacket**

Research at the Southwestern Colorado Research Center during 1991 concentrated primarily on five agronomic areas: edible dry bean breeding, crop variety testing, crop management systems for reduced tillage, irrigation management and Russian wheat aphid studies.

Fifty edible dry bean genotypes were evaluated for yield, leaf movement, leaf temperature and O<sub>18</sub> isotope ratios. Dry bean breeding materials including 52 F<sub>1</sub>, 72 F<sub>3</sub> and 81 advanced lines were evaluated for common bacterial blight, drought resistance and site adaptation. Seed was increased for two experimental lines (CZ 59191 and CZ 59196) being considered for release as varieties.

Variety yield trials were conducted for irrigated pinto beans, irrigated market class dry beans, dryland pinto beans, three wheat classes, plus barley and oats. ID-338 hard-red-winter wheat was released as the variety "Fairview" in the fall of 1991.

Seventeen crop management systems comparing no-tillage, minimum-tillage and conventional tillage systems on non-irrigated cropland were continued into the third year. An inner agency field day was conducted to showcase the project.

Irrigation research included testing and comparing several sprinkler nozzles and developing and testing automatic shut-off valves for side-roll sprinklers. Two irrigation workshops and one field day were held to transfer technology to agriculture producers.

Russian wheat aphid studies included date of seeding comparisons, chemical treatment comparisons and alternate host evaluations.

Research at the Center in 1992 will continue to focus on the programs conducted in 1991. Plans are being formulated to add a modest fruit production project in 1992 to evaluate potential fruit species, irrigation techniques and frost protection practices that may have potential on the newly irrigated lands of the Dolores reclamation project.

# Statement of Revenues and Expenditures by Fund

Budget 1991-92	Actual 1990-91	Actual 19-00-91 Amount	19-00-91 % Amount	19-00-91 % Amount
27,368,240	27,368,240	27,368,240	100.0	100.0
(70,022)	(70,022)	(70,022)	0.3	0.3
7,392,188	7,392,188	7,392,188	27.0	27.0
1,643,074	1,643,074	1,643,074	6.0	6.0
240,000	240,000	240,000	0.9	0.9
29,982,352	29,982,352	29,982,352	109.1	109.1

## Supplemental Information

Budget 1991-92	Actual 1990-91	Actual 19-00-91 Amount	19-00-91 % Amount	19-00-91 % Amount
228,923	228,923	228,923	100.0	100.0
2,162,162	2,162,162	2,162,162	944.5	944.5
(70,022)	(70,022)	(70,022)	30.6	30.6
2,320,144	2,320,144	2,320,144	1,013.5	1,013.5
380,487	380,487	380,487	166.3	166.3
230,787	230,787	230,787	100.8	100.8
830,757	830,757	830,757	363.0	363.0
2,320,144	2,320,144	2,320,144	1,013.5	1,013.5
29,982,352	29,982,352	29,982,352	1,283.1	1,283.1

Sponsored Program - Regional Research

# Statement of Revenues and Expenditures

## Revenues

	Actual 1990-91	Budget 1991-92
State General Fund	\$7,747,212	\$7,968,240
Less: State Recision	(154,944)	(70,052)
Adjusted General Fund	7,592,268	7,898,188
Federal Appropriations	1,643,074	1,714,567
Cash Sales	<u>234,249</u>	<u>240,000</u>
<b>Total</b>	<b><u>\$9,469,591</u></b>	<b><u>\$9,852,755</u></b>

## Expenditures

Administration - Director's Office	\$286,923	\$321,377
Research Program	8,145,799	8,390,196
Less: State Recision	(142,175)	(70,052)
Adjusted Research Program	8,003,624	8,320,144
Utilities	361,046	380,467
Colorado State University		
Plant and Administration	830,767	830,767
Less: State Recision	(12,769)	
Adjusted Plant and Administration	<u>817,998</u>	<u>830,767</u>
<b>Total</b>	<b><u>\$9,469,591</u></b>	<b><u>\$9,852,755</u></b>

Sponsored Program - Regional Research	\$954,939	\$963,124
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## Expenditures by Unit

	Actual 1990-91		Budget 1991-92	
	Amount	%	Amount	%
<b>AES Administration &amp; Program Support</b>				
Director's Office	\$286,923	3.0%	\$321,377	3.3%
Direct Program Support	353,229	3.7	410,822	4.2
Indirect Costs:				
CSU Plant & Administration	817,998	8.6	830,767	8.4
Utilities	<u>361,046</u>	<u>3.8</u>	<u>380,467</u>	<u>3.9</u>
Total	1,819,196	19.2	1,943,433	19.7
<b>Research Centers</b>				
	2,849,921	30.1	2,856,516	29.0
<b>Main Station</b>				
College of Agricultural Sciences	2,612,856	27.6	2,699,823	27.4
College of Engineering	561,140	5.9	587,876	6.0
College of Forestry & Natural Resources	725,335	7.7	738,822	7.5
College of Applied Human Sciences	184,968	2.0	214,013	2.2
College of Veterinary Medicine	485,429	5.1	546,466	5.5
College of Arts, Humanities & Social Sciences	41,977	0.4	26,338	0.3
College of Natural Sciences	<u>188,769</u>	<u>2.0</u>	<u>239,468</u>	<u>2.4</u>
Main Station	4,800,474	50.7	5,052,806	51.3
Total	\$9,469,591	100.0	\$9,852,755	100.0

## Three Year Analysis of Program

	Actual 1989-90		Actual 1990-91		Rescinded Budget 1991-92	
	Amount	%	Amount	%	Amount	%
<b>Source:</b>						
General Fund	\$7,236,486	79.2	\$7,592,268	80.2	\$7,898,188	80.2
Hatch & McIntire Stennis	1,495,534	16.4	1,643,074	17.4	1,714,567	17.4
Cash-Residual Sales from Research	240,000	2.6	234,249	2.5	240,000	2.4
Transfers from SBA	<u>160,000</u>	<u>1.8</u>				
<b>Total</b>	<b>\$9,132,020</b>	<b>100.0</b>	<b>\$9,469,591</b>	<b>100.0</b>	<b>\$9,852,755</b>	<b>100.0</b>

### Application:

<b>AES Administration &amp; Program</b>						
Exempt Salaries	\$4,037,204	44.2	\$4,260,409	45.0	\$4,596,310	46.6
State Classified & Hourly	1,488,916	16.3	1,564,294	16.5	1,436,908	14.6
GRA Salaries & Tuition	887,801	9.7	920,889	9.7	959,725	9.7
<b>Total Personnel</b>	<b>6,413,921</b>	<b>70.2</b>	<b>6,745,592</b>	<b>71.2</b>	<b>6,992,943</b>	<b>71.0</b>
Travel	132,771	1.5	138,266	1.5	146,506	1.5
Operating Expense	985,536	10.8	1,048,196	11.1	1,234,105	12.5
Capital Outlay	329,937	3.6	358,493	3.8	267,967	2.7
<b>Total Administration &amp; Program</b>	<b>7,862,165</b>	<b>86.1</b>	<b>8,290,547</b>	<b>87.5</b>	<b>8,641,521</b>	<b>87.7</b>
CSU Plant & Administration	908,809	10.0	817,998	8.6	830,767	8.4
Utilities	<u>361,046</u>	<u>4.0</u>	<u>361,046</u>	<u>3.8</u>	<u>380,467</u>	<u>3.9</u>
<b>Total</b>	<b>\$9,132,020</b>	<b>100.0</b>	<b>\$9,469,591</b>	<b>100.0</b>	<b>\$9,852,755</b>	<b>100.0</b>

### Selected Data and Relationships:

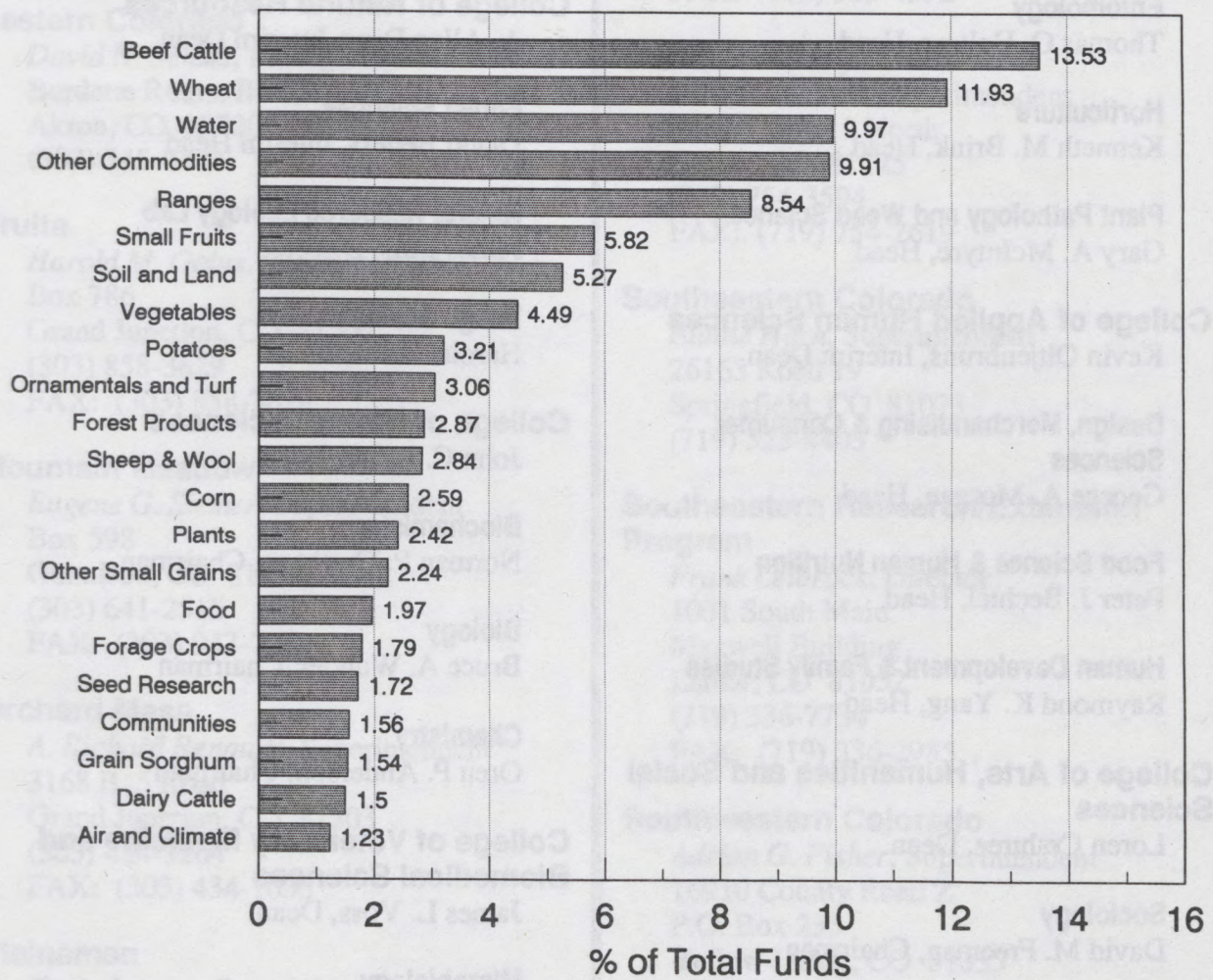
Projects - Beginning	137	127	134
Less: Projects Expired	<u>35</u>	<u>26</u>	<u>33</u>
Subtotal	102	101	101
Add: Projects Revised	15	18	12
New Projects	<u>10</u>	<u>15</u>	<u>28</u>
Projects Continuing	127	134	141
<b>Administrative and Program</b>			
Support per Scientist FTE	\$93,375	\$95,294	\$96,661
<b>Total Support per Scientist FTE</b>	<b>\$106,456</b>	<b>\$108,846</b>	<b>\$110,209</b>
Refereed Journal Articles	181	173	174
Technical Bulletins/Reports	19	14	10
Professional Reports and Reports to Industry	337	391	433



# 1991-92 CAES Research Program Funding

## Summary by Commodity

### Commodity



# Research Departments

## College of Agricultural Sciences

Kirvin L. Knox, Dean

### Agricultural & Resource Economics

S. Lee Gray, Head

### Agronomy

Lee E. Sommers, Head

### Animal Sciences

David R. Ames, Head

### Entomology

Thomas O. Holtzer, Head

### Horticulture

Kenneth M. Brink, Head

### Plant Pathology and Weed Science

Gary A. McIntyre, Head

## College of Applied Human Sciences

Kevin Oltjenbruns, Interim Dean

### Design, Merchandising & Consumer Sciences

George A. Morgan, Head

### Food Science & Human Nutrition

Peter J. Bechtel, Head

### Human Development & Family Studies

Raymond K. Yang, Head

## College of Arts, Humanities and Social Sciences

Loren Crabtree, Dean

### Sociology

David M. Freeman, Chairman

## College of Engineering

Francis A. Kulacki, Dean

### Agricultural & Chemical Engineering

Terry G. Lenz, Head

### Atmospheric Science

Stephen K. Cox, Head

### Civil Engineering

Neil S. Grigg, Head

## College of Natural Resources

A. Allen Dyer, Interim Dean

### Forest Sciences

David Betters, Interim Head

### Natural Resource Ecology Lab

James Ellis, Director

### Range Science

Harold Goetz, Head

## College of Natural Sciences

John C. Raich, Dean

### Biochemistry

Norman P. Curthoys, Chairman

### Biology

Bruce A. Wunder, Chairman

### Chemistry

Oren P. Anderson, Chairman

## College of Veterinary Medicine and Biomedical Sciences

James L. Voss, Dean

### Microbiology

Carol D. Blair, Head

### Physiology

Rupert P. Amann, Head

## Research Centers

### Main Station, Fort Collins

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*Gary Greathouse*, Animal Sciences Coord.  
*Kenneth W. Knutson*, Horticulture Coord.

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### San Juan Basin

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### San Luis Valley

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### Southeastern Colorado

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### Southeastern Research/Extension Program

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### Southwestern Colorado

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### USDA Central Great Plains

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# 1992 Research Center Advisory Committees

## Arkansas Valley Research Center

Allen Aldred  
Ed Blackburn  
Dennis Busch  
Dennis Caldwell  
Stanley Cline  
Bill Elder  
Jim Ellenberger  
Glen Ermel  
Joe Farmer  
Clay Fitzsimmons  
Robert Gerler  
Hans Hansen  
Matt Heimerich  
Robert Jensen  
John Kimbrel  
Mike Mann  
Allen Nicol  
Paul E. Philpott  
Robert Philpott  
Leonard Rink  
Dean Rusher  
John Tomky  
Delbert Wells  
Robert Wiley

## Eastern Colorado Research Center

Don Anderson  
Ward Deering  
Herman Hettinger  
John Holtorf  
Don Koester  
Robert Labore  
Fritz Reid  
Duane Yearous

## Fruita Research Center

James Bernal  
Joe Bernal  
Don Case  
William Cronk  
Charles Currier  
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# 1991 Technical Bulletins and Reports

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	<u>Title</u>	<u>Authors</u>	<u>Dept/s.</u>
<b><u>Technical Bulletins - Limited (LTB's)</u></b>			
LTB 91-1	Floriculture Investigations	Goldsberry, Hopper	Horticulture
LTB 91-2	Proceedings of the Third Inter-mountain Meadow Symposium	Siemer, Koch	Agronomy
LTB 91-3	1991 Colorado Field Day Crop Insect Management Research & Demonstration Trials	Peairs, Pilcher	Entomology
<b><u>Technical Bulletins (TB's)</u></b>			
TB 91-1	Crop and Soil Management in Dryland Agroecosystems	Peterson, Westfall, Sherrod, McGee, Kolberg	Agronomy
TB 91-2	Pine Ridge Zeolite and Fort Hall Mill Shale P Effects on Sorghum-Sudangrass	Barbarick, Eberl, Lai	Agronomy
<b><u>Technical Reports (TR's)</u></b>			
TR 91-1	Mountain Meadow Fertilizer Trials	Follett	Agronomy
TR 91-2	Nitrogen and Phosphorus Soil Test Calibration Study on Dryland Wheat 1989-1990	Soltanpour, Echols Azad	Agronomy
TR 91-3	Sorghum Hybrid Performance Tests in Colorado, 1990	Larson, Schweissing Clay	Agronomy
TR 91-4	42nd Annual Beef Cattle Improvement Report and Sale Data	Brinks, Denham, Schafer	Animal Science
TR 91-5	Application of Anaerobically Digested Sewage Sludge to Dryland Winter Wheat	Barbarick, Lerch Westfall, Follett Ippolito, Jepson	Agronomy

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## 1992 Field Day Schedule

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**March 28 - Colorado State Bull Sale, Fort Collins.**

**April 13 - Colorado State University Beef Improvement Center Bull Sale, Encampment, WY. 9:00 a.m. - Inspection of bulls; 12:30 p.m. - sale of bulls.**

**April 20 - Four Corners All Breed Bull Sale, San Juan Basin Research Center, Hesperus. 12:00 noon.**

**May 19 - Eastern Colorado Research Center Field Day, Akron.**

**June 16 - Joint Mountain Meadow Research Center/Soil Conservation Service "Mini-Field Day". Topic: "Integrated Mountain Meadow Improvement"; 12:00 noon - 3:30 p.m. - Tour to Snowmass, CO. Meet at the USDA-SCS office in Glenwood Springs. RSVP SCS office or Mountain Meadow Research Center.**

**July 8 - Colorado State University Beef Improvement Center Field Day, Encampment, WY. 10:00 a.m. - 3:00 p.m.**

**July 16 - Rogers Mesa Research Center, Hotchkiss. 9:00 a.m. - 3:00 p.m. In cooperation with the Western Colorado Horticultural Society. Will cover current research including a newly planted, high-density, microsprinkler-irrigated, systems trial; peach and apple rootstock plantings; apple variety plantings; hyper-density 'Golden Delicious' planting; deer impact study; and several apple fruit sunburn studies.**

**July 17-18 - Composite Cattle Breeders Conference, San Juan Basin Research Center, Hesperus.**

**July 24 - Mountain Meadow Research Center Field Day; Joint with cities of Aurora, Thornton and Denver. Topic: "South Park Meadows: before, during, and after transfer of water rights." 8 a.m. - Meet across U.S. 285 from The Jefferson Store, Jefferson, CO. Bring lunch and waterproof boots. Tour returns to Jefferson at 4:00 p.m. RSVP required.**

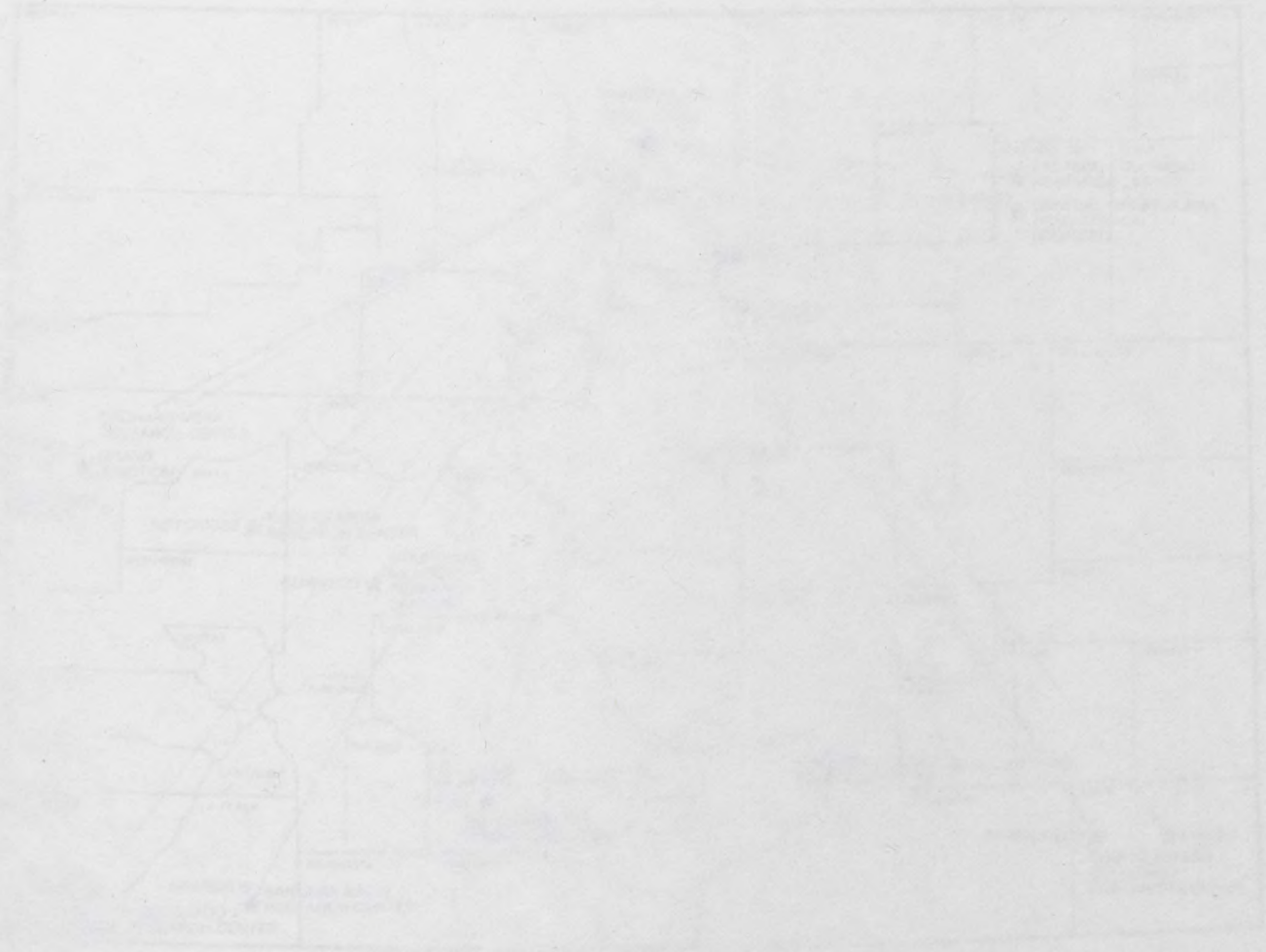
**July 24 - Horticulture Research Center, Fort Collins (near Anheuser Busch, off I-25 and Mountain Vista Drive); 8:00 a.m. - 4:00 p.m. Review of turfgrass and landscape horticulture research projects. Call (303) 491-7018 for registration and information.**

**July 28 - San Luis Valley Research Center, Center. 8:30 a.m. - Registration; 9:00 a.m. - 4:00 p.m.: Potato disease research, potato growth analysis, potato breeding and selection, small grain trials, and new crops research. Lunch served courtesy of local businesses.**

**September 3 - Plainsman Research Center Field Day, Walsh. 11:00 a.m. - Dryland no-till rotations (6 mi. south of Walsh, 4 mi. east, 1.5 mi. south); 12:00 - lunch at Plainsman Farm (4 mi. north of Walsh, 1.5 mi. west, 0.5 south); 1:00 p.m. - Plainsman Farm Field tour of alternative crops; row spacing in grain sorghum; sorghum variety trials; limited irrigation on corn & sorghum; dryland corn; early maturing corn under LEPA-equipped sprinkler.**

**September 10 - Arkansas Valley Research Center, Rocky Ford. 3:30 p.m. - Crop and Pest Management.**





# 1992 Field Day Schedule

March 28 - Colorado State Bull Sale, Ft. Collins.

April 13 - Colorado State University Beef Improvement Center Bull Sale, Evansville, WY, 860 a.m. - Auction of bulls: 12:30 p.m. - sale of bulls.

April 20 - Beef Cattle All Breed Bull Sale, San Jose State Research Center, Winters, 12:50 a.m.

May 19 - Eastern Colorado Research Center Field Day, Alton.

June 25 - Joint Wyoming/Utah State Research Consortium, "Landscape Research: Integrated Use of the Colorado Plateau Region," 8:00 a.m. - 4:00 p.m. - Registration, 8:00 a.m. - 9:00 a.m. - Review of landscape research projects. Call (303) 491-8013 for registration and information.

July 6 - Joint Wyoming/Utah State Research Consortium, "Landscape Research: Integrated Use of the Colorado Plateau Region," 8:00 a.m. - 4:00 p.m. - Registration, 8:00 a.m. - 9:00 a.m. - Review of landscape research projects. Call (303) 491-8013 for registration and information.

July 26 - Eastern Colorado Research Center Field Day, Alton. 8:00 a.m. - Registration, 8:00 a.m. - 9:00 a.m. - Review of landscape research projects. Call (303) 491-8013 for registration and information.

July 27 - Eastern Colorado Research Center Field Day, Alton. 8:00 a.m. - Registration, 8:00 a.m. - 9:00 a.m. - Review of landscape research projects. Call (303) 491-8013 for registration and information.

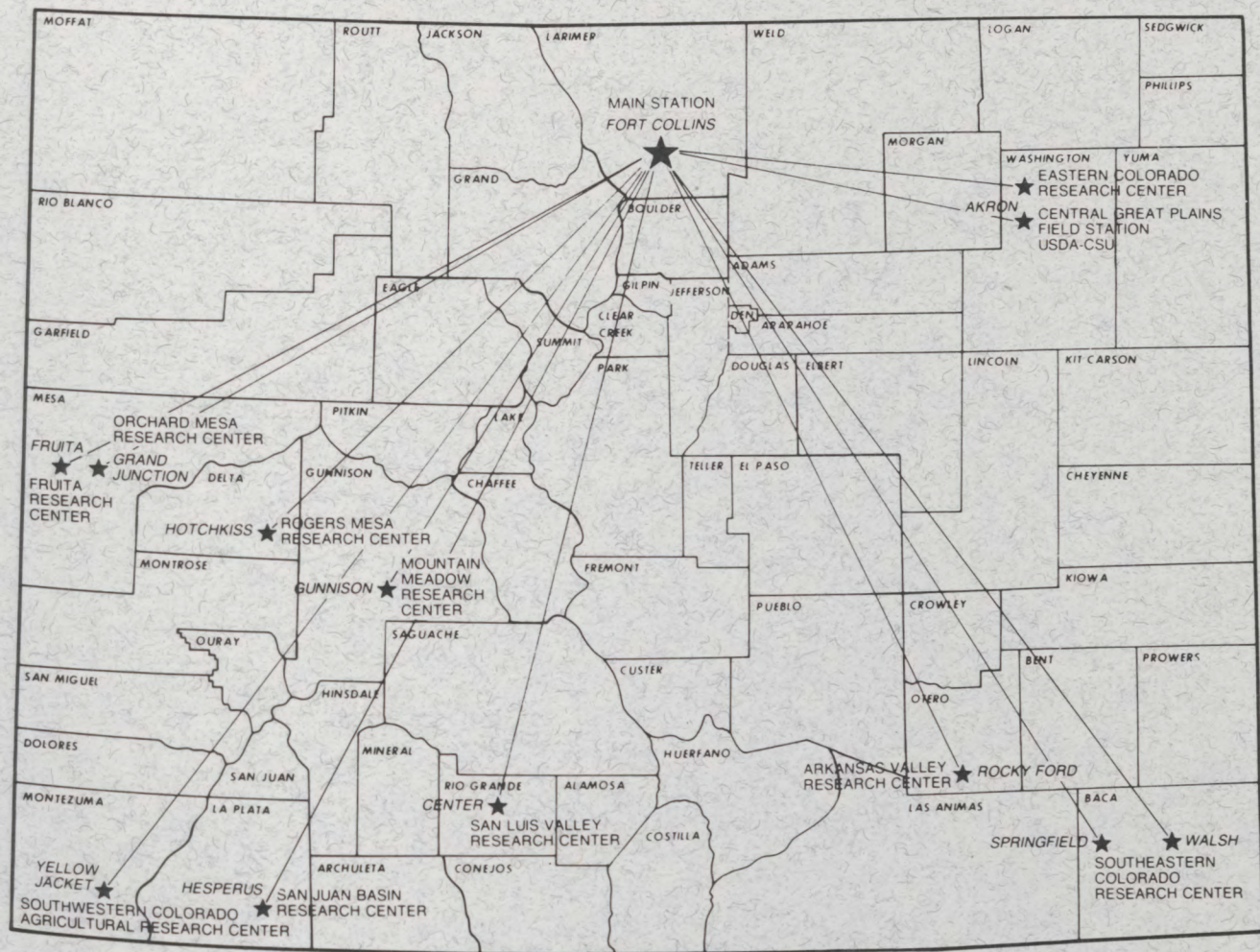
July 24 - Mountain Meadow Research Center Field Day: Joint with cities of Aurora, Thornton and Denver. Topic: "South Park Meadows: before, during, and after transfer of water rights." 8 a.m. - Meet across U.S. 285 from The Jefferson Store, Jefferson, CO. Bring lunch and waterproof boots. Tour returns to Jefferson at 4:00 p.m. RSVP required.

July 24 - Wetland Research Center, Fort Collins (near Anheuser Busch, off I-25 and Mountain Vista Drive). 8:00 a.m. - 8:30 p.m. Review of landscape research projects. Call (303) 491-8013 for registration and information.

July 28 - San Luis Valley Research Center, 8:30 a.m. - Registration, 9:00 a.m. - 4:00 p.m. - Potato disease research, potato growth analysis, potato breeding and selection, small grain trials, and new crop research. Lunch served courtesy of local business.

September 3 - Panhandle Research Center Field Day, Walsh, 11:00 a.m. - 6:00 p.m. - 8:00 a.m. - Registration, 8:00 a.m. - 9:00 a.m. - Review of landscape research projects. Call (303) 491-8013 for registration and information.

September 10 - Arkansas Valley Research Center, Rocky Ford, 8:30 a.m. - Crop and Soil Management.



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