Colorado State University

1988 Annual Report

Agricultural Experiment Station
Colorado State University, Fort Collins, Colorado 80523

Colorado State University

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DIRECTOR'S REPORT

To Friends of the Agricultural Experiment Station:

In addition to celebrating the 100th Anniversary of the Colorado Agricultural Experiment Station during the past year, we have continued planning our direction for the future.

The station must be even more successful in the future than in its first 100 years in generating new knowledge necessary for agriculture in the 1990's and beyond.

Pressing problems face agriculture. It is faced with increased competitiveness in international markets. Consumers are increasingly concerned about the safety, quality and nutritional value of food. Agricultural firms, including family-sized farms, are frequently called upon to decrease the use of chemicals in the production of food because of the potential impact on water quality. The agricultural community is being asked constantly to deal with major surpluses and depressed prices. At the same time, the industry is expected to maintain an adequate quantity and quality of food and fiber, this in the face of diseases, insects, droughts, hail, and other well-known risks to the industry. Global climate change, depletion of the ozone layer, and acid-rain may dramatically affect agriculture in the future. And finally, new nonfood uses for crop and animal products need to be developed.

Clearly, research advances are essential to establish the knowledge base that Colorado agriculture will require to deal with complex issues in the decades ahead.

We invite you to join us in establishing our direction for the future by sharing with us your ideas, concerns and support. May 1989 be the "best ever" year for Colorado agriculture.

CELEBRATING THE AGRICULTURAL EXPERIMENT STATION'S FIRST CENTURY

The first century of the Colorado Agricultural Experiment Station was a major focus of events surrounding the Colorado Agricultural Initiative during 1988. The Initiative is a joint endeavor with Cooperative Extension since that program celebrates its 75th year in 1989. Our intent was to recognize past accomplishments and to identify challenges ahead for agriculture. The theme chosen for the endeavor was: **AGRICULTURE, the essential investment.**

A special exhibit about agriculture in its broadest sense was displayed at major events such as the National Western Livestock Exposition, the Colorado Farm Show in Greeley, the Garden and Home Show in Denver, AG Day '88, and field days held by the research centers.

The most ambitious undertaking was major displays related to agricultural research as a part of the industry/technology exhibit focusing on agriculture at the 1988 Colorado State Fair. This was made possible through the cooperation of the University of Southern Colorado and its chief coordinator of industry and technology building, Jerry L. Sweet. The displays at the State Fair included such topics as:

- beef cattle energy requirements
- drought and water supply
- dry beans in Colorado
- the economics of agricultural enterprises
- the Food Research and Development Center
- high mountain/brisket disease
- insect pests and their control
- irrigation devices and water management
- one hundred years of research on potatoes and wheat
- restructured meat
- the weed problem in Colorado

A series of seminars focused on the future of agriculture. The first of these in late March was keynoted by Governor Roy R. Romer. Outstanding scientists from around the country addressed such topics as:

- The future role of agriculture in the Colorado economy
- Future impacts of advanced technologies on agriculture
- Sustainable agriculture and other production alternatives
- Control, conservation and consumption of Colorado water
- Natural resource management and its effect on the future
- Food and consumer concerns: nutrition, safety and quality
- Agricultural policy: its impact on rural America
- Contemporary agriculture and rural society in the year 2000
- Agriculture: the essential investment

The seminars were closed with a luncheon at which previous directors of the Colorado Agricultural Experiment Station were recognized. The speaker for the occasion was John Patrick Jordan, Administrator of the Cooperative State Research Service of the U. S. Department of Agriculture. Dr. Jordan, former director of the Colorado station, spoke on the future of agricultural research: opportunities and challenges.

As a part of the Anniversary Banquet celebrating the station's Centennial and the Diamond Jubilee of Cooperative Extension, the Colorado Agricultural Experiment Station presented five Centennial Awards to individuals who have made extraordinary contributions to agricultural research. Those cited were:

- *Harold H. Broughton*, Delta, for his respected leadership in and service to the Colorado fruit industry.
- *John C. Holtorf*, Yuma, for his exemplary Hereford enterprise and his contributions to the control of animal diseases.
- *Ted R. Still*, Monte Vista, for his singular contributions to the improvement of potatoes.
- *Howard H. Stonaker*, Fort Collins, for his pioneering the science of animal breeding both domestically and internationally.
- *Robert S. Whitney,* Fort Collins, for his exemplary career as a soil scientist and administrator.

In addition to these Centennial Awardees, the Agricultural Experiment Station, through the academic departments or outstate research centers, has recognized others who have made special contributions to the work of the station. Histories of our research centers and their current program have been prepared and are available at the centers. These histories recognize the continuing contributions of the centers to the state's agricultural industry. We hope to continue to communicate with you about the significant work being accomplished. We are optimistic about the Station's second century.

RESEARCH PLANNING AND EVALUATION

Over the past three years, we have evaluated our overall research program to establish a set of research goals, to identify our strengths and weaknesses and to evaluate on-going projects in terms of addressing research goals and attaining meaningful research productivity. As a result of this planning process, we have identified seven research goals and research areas addressing the goals. See Exhibit 1.

These goals are being incorporated in the development of a five year research plan. The plan will include research objectives at each of our research centers. The objectives are being developed through each center's research advisory committee. The final result is expected to be a comprehensive statewide research plan.

All existing research projects have been evaluated to ascertain that the research contributes to one or more of the goals. New and proposed projects

will be critiqued similarly. On going process will occur annually, including the assessment of research productivity.

From the analysis of our strengths and weaknesses, we found our program consists of two basic elements. A large share of the endeavors from the base program encompass a host of continuous investigations essential to maintaining the productive capability of agriculture and the capacity to conduct research to address emerging problems and concerns. The second element is targeted to opportunities for enhancing the economic potential of agriculture.

We must identify and develop those innovations in technology that will increase the economic efficiency and competitiveness of agricultural producers and processors, and expand the economic base of agriculture through value-added processing of new or existing raw commodities/products. Our analysis identified four critical program areas which require significant development or strengthening over the next five years. These program areas are:

- **Agricultural Biotechnology.** Technological developments such as biotechnology hold considerable promise for agriculture. The integration of recombinant DNA and tissue culture techniques in the plant and related sciences offers not only production efficiencies, but potential for new products and important breakthroughs for reducing our dependency upon agricultural chemicals. This takes on special meaning as more and more of the "standard" agricultural chemicals such as fungicides, herbicides and nitrogen fertilizers are being questioned and may not be available to producers in the future. Similar technological advances are occurring with respect to animal growth, development, reproduction and disease resistance. Biotechnology also spawns new investment opportunities and new industries with associated job growth.

- **Research Center Research Capacity.** A plan is being prepared to address current and longer term capital equipment, capital outlay, and physical plant maintenance and operations at research centers. Research centers will actively support the biotechnology and integrated systems initiatives.

- **Integrated Systems.** Integrated systems research is an interdisciplinary research initiative using agricultural sciences expertise coupled with mathematical and decision science modelling and information management. The purpose of the research is to understand the production, processing, marketing and economic consequences of a management decision. It is intended to build upon the data produced from prior individual research studies, build an interface between data

sets to understand the interaction of input and other variables, and to simulate or predict the consequences of management decisions on enterprise profitability.

- **Value Added Through Processing Technology and Product Development.** Colorado's agricultural commodities are generally sold as raw commodities. The value added component of the agricultural industry is equal to the amount of raw commodities produced on farm, a 1:1 ratio. Value added includes the cost of raw materials plus processing and related costs to create the final product in Colorado. Other states with comparable on-farm value enjoy ratios of 3:1 of value added to on-farm value. This favorable ratio indicates that food and product processing and technology is an important component of the agricultural industry in these states. This activity results in increased employment and an overall enhancement to a state's economic base.

In addition to requesting funds to maintain our current program, including work on Russian Wheat Aphid, we requested additional funds to address the four critical areas. The current request in each area is the first stage. Future requests will be required to meet the objectives of each area. A summary of the request for additional support is:

	Current Request	Future Request
Agricultural Biotechnology	$222,000	$700,000
Research Center Research Capacity	224,178	737,988
Integrated Systems	167,000	48,000
Value Added Through Processing Technology and Product Development	262,000	431,000
Total	$875,178	$1,916,988
Personnel, operating expense, etc.	$655,000	$679,000
Capital outlay/maintenance	220,178	1,237,988
Total	$875,178	$1,916,988

The current request for Agricultural Biotechnology is for (1) a plant virologist to work on such problems as Barley Yellow Dwarf Virus, wheat streak mosaic, viruses of potatoes and fruit; and (2) a nematologist to work on crops such as potatoes, alfalfa, tree fruits, onions, sugar beets and corn which are affected by nematodes. Future requests will be for additional expertise in molecular genetics and biology which will be needed to provide the core of biotechnology researchers to address current and emerging problems.

Additional funds are required to (1) update research centers' equipment and facilities, (2) provide sufficient research staff and support to address local research needs, and (3) support advances in biotechnology and integrated systems. Research center personnel will be important components in such programs as Integrated Resource Management research in crops and livestock.

The livestock Integrated Resource Management (IRM) program has been described as innovative, on the cutting edge of technology development, effective in transferring research and technology in a timely manner and an excellent approach for improving the well-being of agriculture. Increased support has been requested to initiate a beef IRM subprogram in southeast Colorado as part of the new regional research/extension integrated activity; a new team for the San Luis Valley and mountain ranching areas centered at Gunnison; and development of an integrated systems approach for livestock feeding.

In addition to serious threats from pests and disease, crop producers are faced with marketing problems, extremely high input costs, and constraints on the use of chemicals due to environmental concerns. And like livestock producers, crop producers do not have reliable data to determine which technologies and management decisions result in profitable and environmentally acceptable enterprises.

Resources were requested to initiate a crops IRM program. The requested funds will implement a crops IRM program in Southeast Colorado as part of the new Southeastern Colorado Research/Extension regional program and a commodity specific program on potatoes in the San Luis Valley and Northeastern Colorado. A team comprised of production, processing and marketing scientists and extension personnel, working with local producers and processors will develop enterprise models to improve economic efficiencies of production. In conjunction with the research, they will determine processing and marketing strategies for raw products. This team will be closely linked with the livestock IRM team as well as processing researchers to evaluate economic opportunities.

The initiative in value added and product development has two components. One is developing new products using biotechnology to obtain necessary economies to introduce a viable new product. Such products may include food and non-food uses of Colorado commodities. The second is development of processing, marketing, and delivery systems capability to increase the value added component.

SOUTHEAST COLORADO RESEARCH/EXTENSION REGION

An innovative approach to managing research and extension programs is being implemented in Southeast Colorado. The boundaries of the region include the area served by the research centers located at Walsh, Springfield and Rocky Ford and the existing Southeast Extension region, a total of seven counties. Ed Langin has been appointed the coordinator of research/extension for this region.

This regional approach is expected to:

- ensure that research and extension programs focus on priorities determined cooperatively by research, extension and private industry.
- provide a mechanism for close coordination, cooperation and integration of on- and off-campus research and extension activities.
- develop short- and long-term goals and a program plan that identifies program and budgetary responsibilities and commitments for achieving goals.
- build an advisory and program development and implementation committee structure for developing and carrying-out goals.
- identify the type of resources and expertise required to support agriculture in the region, the placement of resources within the region, and build a stronger bridge between on- and off-campus researchers in meeting regional priorities.

RUSSIAN WHEAT APHID RESEARCH

Research in the Russian Wheat Aphid problem was initiated in Spring 1988 with a supplemental appropriation approved by the legislature. Several experiments are being conducted statewide by four regional entomologists based at Lamar, Akron, Center and Fruita as well as researchers engaged in plant breeding and variety testing.

The overall research is addressing three priorities as follows:

Priority 1: Conduct research related to improving chemical control: monitor resistance of insects to insecticides; develop base data for assessing economic thresholds; assist with suction trap network; develop database on basic biology and ecology; evaluate effectiveness of bio-control; coordinate with agronomists on cultural control methods; and disseminate information to producers and industry.

Priority 2: Accelerate plant breeding program to develop varieties resistant to the RWA. To broaden variety testing program to provide the experimental and demonstration plots for evaluating varieties, treatments for control and impact of RWA on wheat quality and yield.

Priority 3: To conduct research on cultural control methods in specific environments, i.e., climatic and soil.

Among the current work is the identification of a potential resistant wheat variety. Development of the variety for production will likely take until 1994. There are no quick solutions to this problem.

CAPITAL CONSTRUCTION FUNDING FOR NORTH AGRICULTURAL CAMPUS

We have submitted a capital construction request to the legislative capital development committee for developing the North Agricultural Campus at Fort Collins. The present South Agricultural Campus is leased on a year to year basis. There are no guarantees the lease will be renewed each year. Therefore, agronomic research is being limited to short-term studies.

Several years ago, 390 acres were acquired seven miles north and east of the CSU campus to develop the North Agricultural Campus. The North Agricultural Campus is planned to be integrated state-of-the-art research and instructional field facility. The initial phase will develop a field laboratory for the Departments of Agronomy, Agricultural and Chemical Engineering, Plant Pathology and Weed Science, and Entomology. A second phase will integrate certain activities of the Department of Animal Sciences.

This center will be a field laboratory for testing research emanating from on-campus greenhouses, laboratories and growth chambers. It is especially critical for testing and validating projects under environmental conditions of northeast Colorado, to establish viability of varieties in the environment and for establishing procedures for other geographic areas of the state.

Although the Commission on Higher Education (CCHE) has given this construction project a relatively high priority, the legislative capital development committee has ranked the project lower than other CCHE priorities, thereby placing any funding in question for the current year. We must continue to press for funding for this critical need.

Robert D. Heil, Director
March, 1989

Exhibit 1. Agricultural Research Goals

The AES has established seven goals for agricultural research in Colorado which are:

GOAL: Ensure the Natural Resources Essential to a Productive Agriculture

Description: Soil and water are primary factors in the production of food and fiber. Wind and water erode organic matter and degrade the environment. Soil types affect the transport of sediment and chemicals. Uses of lands influence not only productivity levels but also water quantity and quality, aesthetic and recreational elements.

Research Areas: properties of soils and their management;
water quality, conservation, and management;
land use alternatives.

GOAL: Protect Crops, Forests and Livestock from Diseases, Insects and Other Pests

Description: Development of resistance in animals and plants and other control methods must be studied in concert with changes in pest and disease organisms. Improved control methods are being studied to reduce economic losses and minimize environmental degradation.

Research Areas: biological, chemical, cultural and other control methods;
integrated systems for management of pests.

GOAL: Optimize Supply and Cost Relationships of Agricultural, Forest and Nursery Production

Description: Biotechnology has widened horizons for the genetic potential of plants and animals. Emerging technologies affect producer costs, capital requirements and risk management. Computer modeling of crop and livestock systems allows simultaneous consideration of multiple variables. Not only are production costs and commodity prices important but also enterprise alternatives.

Research Areas: biological efficiencies of animals and plants;
integrated crop and livestock systems;
market forces and enterprise profitability;
animal health and disease.

GOAL: Expand the Markets for Agricultural, Forest and Nursery Products

Description: Developing alternative uses for agricultural products offers potential for increasing demand for existing products. Processing capability within Colorado would enhance the overall value of agricultural products. Quality can be an effective form of product differentiation.

Research areas: alternative uses;
processing technology;
product quality.

GOAL: Strengthen the Marketing System for Agricultural Products

Description: Consistent measures of product quality communicate standards of value to consumers. Governmental regulations and marketing policies influence marketing strategies of producer groups as well as other economies. Trade policies affect the concentration, penetration, and stability of markets.

Research Areas: grades and standards;
market strategies;
trade policies.

GOAL: Ensure the Nutritional Quality and Safety of the Food Supply

Description: Nutritional requirements are influenced by physiological and environmental factors. Dietary practices and quality of foodstuffs influence the adequacy of diets. Production, processing and preparation practices affect the nutritional quality and safety of food. The components of food influence human health; however, the nature and extent of those influences are not well understood.

Research Areas: human nutritional requirements;
interrelationships among food, nutrition and health;
bioavailability of nutrients;
microbial and chemical agents in foodstuffs.

GOAL: Enhance the Well Being of Rural Families and Communities

Description: The fabric of an agricultural community is woven from its people who include the producers, processors and service providers. Communities must adjust to change just as families and individuals must adapt to their changing circumstances. The economic status of a community evolves from the status of the individuals who comprise it. Changing demographics influence the structure of communities.

Research Areas: Impacts of social, economic and technological changes on individuals, families, and communities;
service needs, delivery systems and economic alternatives in nonmetropolitan areas;
institutional alternatives and funding mechanisms.

STATEMENT OF REVENUES AND EXPENDITURES

	ACTUAL 1987-88	ESTIMATED 1988-89
REVENUES:		
State General Fund	$6,730,044	$7,265,239
Federal Appropriations	1,500,843	1,634,268
Cash Sales	240,000	240,000
Total	*$8,470,887*	*$9,139,507*
EXPENDITURES:		
Administration - Director's Office	$289,799	$310,773
Research Program	6,687,415	7,134,914
Russian Wheat Aphid	235,725	406,000
Utilities	381,988	411,860
Colorado State University Plant and Administration	875,960	875,960
Total	*$8,470,887*	*$9,139,507*

RESEARCH DEPARTMENTS

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Blaine Horn, Superintendent (Range Science)

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U.S. CENTRAL GREAT PLAINS (USDA), Akron

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Jay Spiers
Mark Wagers
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TECHNICAL BULLETINS and TECHNICAL REPORTS

Technical Bulletins

	TITLE	AUTHOR/S	DEPT./S
TB-88-1	Response of Sorghum Sudangrass in Soils Amended with Phosphate Rock and NH_4 - Exchanged Zeolite (Clinoptilolite)	Barbarick, Lai, Eberl	Agronomy

Technical Bulletins - Limited

LTB-88-1	Projecting Economic Impacts of New Industry in Colorado with IMS Micro-computer Software and USDA IMPLAN DATA Synthesizer	McKean, Spencer, Winger	Agricultural and Resource Economics
LTB-88-2	Soil Testing Methods at Colorado State University for the Evaluation of Fertility, Salinity, and Trace Element Toxicity	Workman, Soltanpour Follett	Agronomy
LTB-88-3	Selection of Standard Free Energies of Formation for Use in Soil Chemistry. Selenium Supplement to Technical Bulletin 134	Elrashidi, Adriano, Lindsay	Agronomy
LTB-88-4	Fluorine Supplement to Technical Bulletin 134	Elrashidi, Lindsay	Agronomy
LTB-88-5	Profile Distribution of Zinc, Iron, Manganese and Copper in Colo. Soils	Follett, Lindsay	Agronomy
LTB-88-6	Crop and Soil Management in Dryland Agroecosystems	Peterson, Westfall	Agronomy
LTB-88-7	FORSTAR a Forest Simulation for Teaching and Research	Day, Betters	Forest and Wood Science
LTB-88-8	Grazing and Seeding Research at SE Colo. Exp. Station, Springfield, CO	Cook, Rittenhouse	Range Science
LTB-88-9	Iodine Supplement to Technical Bulletin 134. Selection of Standard Free Energies of Formation for Use in Soil Chemistry	Michail, Lindsay	Agronomy

Technical Reports

	TITLE	AUTHOR/S	DEPT./S
TR-88-1	Performance Tests of Corn Hybrid Varieties, Corn Population Studies, and Soybean Varieties in Colorado, 1987	Echols, Croissant, Schweissing, Golus, Pearson, Hain, Ristau, Miklas	Agronomy, Arkansas Valley and Fruita Research Centers
TR-88-2	Sorghum Hybrid Performance Tests in Colorado, 1987	Youngman, Langin, Schweissing	Agronomy, SE Colorado and Arkansas Valley Research Centers
TR-88-3	Evaluation of Sulfur Fertilization of Dryland Winter Wheat	Follett, Westfall, Vaughan	Agronomy
TR-88-4	39th Annual Beef Cattle Improvement Report and Sale Data	Brinks	Animal Science & San Juan Basin Research Center
TR-88-5	Fertilization Recommendations Comparison Study	Follett, Westfall	Agronomy and Soil Testing Lab
TR-88-6	Variety Performance Tests and Nitrogen Fertility Trial of Dry Beans in Western Colorado, 1985-87	Pearson, Golus	Agronomy and Fruita Research Center
TR-88-7	Variety Performance, Inoculation, Row Spacing, and Nitrogen Fertilization of Soybean in Western Colorado, 1987	Pearson, Golus	Agronomy and Fruita Research Center
TR-88-8	Application of Anaerobically Digested Sewage Sludge to Dryland Winter Wheat	Lerch, Barbarick, Westfall	Agronomy
TR-88-9	Determining the Most Profitable Amount of Nitrogen to Apply on Winter Wheat	Feuz, Follett, Echols	Agronomy

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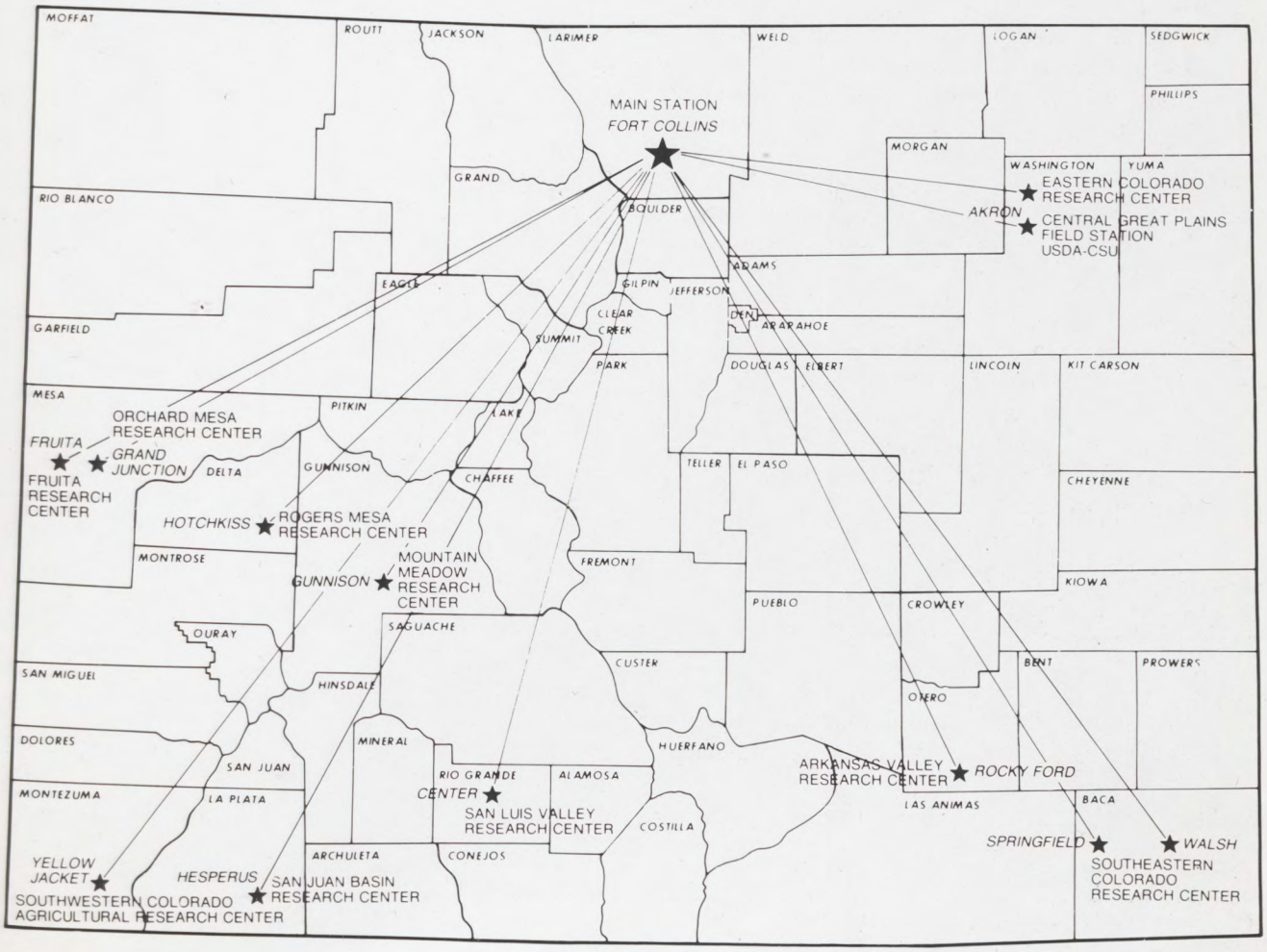
1989 RESEARCH CENTER FIELD DAY SCHEDULE

April 8	**Eastern Colorado Research Center,** Akron. 11:30 a.m. Northeast Colorado Bull Test Sale.
April 17	**Colorado Beef Improvement Center**, Saratoga, WY. 12:30 p.m. Bull Sale. Bulls on display from 9:00 a.m. until sale time.
April 24	**San Juan Basin Research Center**, Hesperus. 12:00 noon. Four Corners Bull Test Sale.
May 16	**Eastern Colorado Research Center**, Akron. 10:00 a.m. View cattle and facilities; noon lunch and afternoon program.
May 18, 19	**Southeastern Colorado Research Center,** Springfield. 8:00 a.m. Review range and conservation research in conjunction with the Colorado Society of Range Management, the Colorado Branch of Holistic Resource Management, and the Colorado Chapter of Soil and Water Conservation Society.
June 12, 13	**Mountain Meadow Research Center,** Gunnison. June 12: Crawford -10 a.m. to 12:30 p.m.; Gunnison - 3 p.m. to 6:30 p.m. (Research Center & field sites). June 13: Leadville - 10 a.m. to 12:30 p.m.; Yampa - 3 to 5 p.m. (Specific sites to be announced at a later date.)
June 21	**Central Great Plains USDA Field Station,** Akron. 9:00 a.m. - 1:00 p.m. Review current research dealing with winter wheat varieties; irrigation and weed management; soil fertility and crop rotations; and crop water stress.
July 13	**Orchard Mesa Research Center**, Grand Junction. 9:30 a.m. Review research on peach and apple replant diseases, mycoplasma diseases, pear rust, mite and insect pests, fruit varieties, and ways to alleviate winter injury.
July 27	**Fruita Research Center**, Grand Junction. 4:00 p.m. Review current research in agronomy, Russian Wheat Aphid, and irrigation programs.
Aug. 8	**Colorado State University Agricultural Field Day,** Fort Collins. 2:00 p.m. Bay Farm Research Facility. Review research in Plant Pathology/Weed Science, Entomology, and Botany. 4:30 p.m. Agronomy Research Center. Review research on forage crops, corn, sorghum, millets, dry beans, soybeans and alternative crops.



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