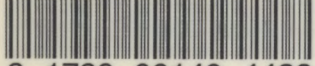


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Annual Report

1985

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Agricultural Experiment Station

Colorado State University

Colorado State University

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Agricultural Experiment Station

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Colorado State University does not discriminate on the basis of race, color, religion, national origin, sex, age, veteran status, or handicap. The University complies with the Civil Rights Act of 1964, related Executive Orders 11246 and 11375, Title IX of the Education Amendments Act of 1972, Sections 503 and 504 of the Rehabilitation Act of 1973, Section 402 of the Vietnam Era Veteran's Readjustment Act of 1974, the Age Discrimination in Employment Act of 1967, as amended, and all civil rights laws of the State of Colorado. Accordingly, equal opportunity for employment and admission shall be extended to all persons and the University shall promote equal opportunity and treatment through a positive and continuing affirmative action program. The Office of Equal Opportunity is located in Room 314, Student Services Building. In order to assist Colorado State University in meeting its affirmative action responsibilities, ethnic minorities, women, and other protected class members are encouraged to apply and to so identify themselves.

HISTORY

When I assumed the position of director of the Colorado Agricultural Experiment Station on November 1, 1984, I told our scientists that two things were essential for us to fulfill our mission — addressing high-priority research needs and improving agricultural research productivity.

I'm pleased to report the scientists have joined with me in this commitment.

This annual report is an important step in accounting for our program. While only a small portion of our research can be described in any one publication, this report is an attempt to summarize the diversity of research conducted by CAES scientists. This research diversity is essential to address Colorado's highly complex and diversified agriculture.

Colorado's economy has been and continues to be driven by its natural-resource base. Agriculture, a major component of that base, is an important contributor to the state's economy. The farm-gate value of agricultural crop and livestock sales was \$3.3 billion in 1984. Adding a multiplier factor of four makes agriculture a \$13.2 billion contributor to the state's economy.

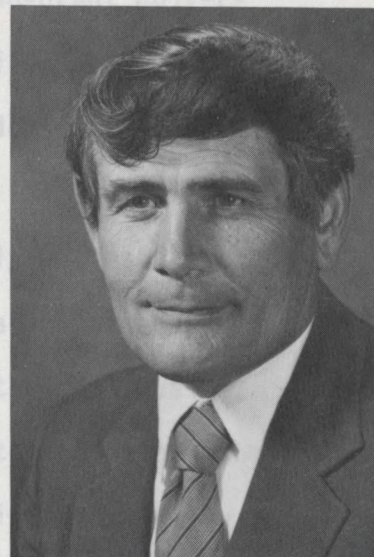
The Colorado Agricultural Experiment Station faces many demands on its resources and expertise in order to address the challenges of the '80s. The Agricultural Experiment Station mission is to conduct research that helps maintain agriculture as a major contributor to and stabilizer of the state's economy and to enhance this potential in the future.

I'm convinced the Agricultural Experiment Station's mission to conduct a quality and responsive research program is the key to maximizing agricultural economic stability and enhancing agriculture's contribution to the citizens of Colorado.

Many of you have been asked to help establish research priorities. We will continue to ask the rural communities to help us evaluate our programs to ensure their responsiveness to the needs of Colorado agriculture.

This annual report outlines our current research direction, discusses recent progress and achievements and contains a bibliography of research publications produced by our scientists.

We are interested in your opinions on our research direction. Tell us what you like or don't like about our research efforts.



R. D. Heil, Director
Agricultural Experiment Station



R. D. Hall, Director
Agricultural Experiment Station

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HISTORY

The Morrill Act of 1862 established the concept of land-grant universities and provided the means by which the states could build those universities. By 1870 Colorado's land grant institution, Colorado State University, had become a reality.

The Colorado Agricultural Experiment Station officially was established in 1888 and charged with the responsibility for research basic to needs related to all aspects of agriculture. It was to do this through studies, scientific investigations and experiments that contribute to the establishment and maintenance of a permanent and efficient agricultural industry in Colorado.

During its 98-year history, the Colorado Agricultural Experiment Station has expanded its research program into a statewide system of laboratories, greenhouses and field facilities at the main station in Fort Collins and 11 research centers throughout the state. Research is conducted in eight program areas by scientists from 32 departments located in seven colleges.

The 1887 Hatch Act that established agricultural experiment stations and the 1914 Smith-Lever Act that originated the Cooperative Extension brought about the union of instruction, research and service at land-grant institutions. The land grant institution provide the environment in which to conduct research programs on difficult problems requiring years to solve.

THE CHALLENGE

Technologies that farmers need to remain competitive are costly and complex. To help producers deal with problems of a depressed agricultural economy, the research and education community must develop research and education programs focused on increasing profitability. These programs require a

multidisciplinary-systems approach aimed at optimizing profit through integration of management, production and marketing. The goal is maximum profit, not necessarily maximum production and at the same time optimizing use of the natural resource base.

To remain competitive, modern agriculture must maintain a highly qualified cadre of scientists and professionals and provide them with the resources and support to continue research efforts in a wide range of multidisciplinary areas.

PLANNING PROCESS

In 1983 the Colorado Agricultural Experiment Station initiated a plan to improve the effectiveness of research programs. This planning process involves input from commodity groups, general farm organizations, scientists, extension personnel and state agencies. This initiative includes:

- a long-term research-needs assessment for serving Colorado agriculture;
- identified research goals on which to build a research plan. A research plan to meet these long-term needs;
- an annual research-objectives assessment that presents the Colorado Agricultural Experiment Station's priorities for the next fiscal year and required financial support;
- an annual accomplishment report specifying on-going research programs and accomplishments along with expectations for the future.

These four activities are interrelated and constitute current efforts to develop an overall strategic-planning process that provides the Colorado Agricultural Experiment Station with a way to determine and direct the program toward high-priority research needs.

GOALS AND OBJECTIVES

From this planning process, 20 major, long-term research and research-management goals have been identified:

1. Strengthen research programs in soil management.
2. Strengthen and expand programs on surface and ground water use, conservation management, irrigation efficiency and water quality.
3. Strengthen and assess management practices and systems to improve range, forest and wildlife management.
4. Expand research for controlling weeds, insects, diseases and other pests of plants and livestock.
5. Strengthen research to improve efficiency of energy use.
6. Strengthen and expand research to develop systems to optimize crop and animal production through integration of physical, biological and socio-economic factors.
7. Expand research in genetic engineering and biotechnology.
8. Expand research in the development of new and alternative crop and livestock enterprises.
9. Strengthen research programs in animal breeding, nutrition, repro-

duction, health and genetics.

10. Maintain strong crop-breeding programs.
11. Expand research programs to develop applications of computer technology and electronic sensing systems.
12. Expand research programs in production, marketing and processing to increase the value-added quality and marketing potential of Colorado agricultural products.
13. Strengthen and expand research in agricultural finance, credit and policy.
14. Expand research to assure the nutritional value, quality and safety of the food supply.
15. Strengthen research to evaluate the impact of socio-economic and institutional changes on rural families and communities and the effect of these changes on consumer needs and use of agricultural products.
16. Plan and maintain a balanced program of basic and applied research.
17. Improve coordination and strengthen statewide research programs.
18. Upgrade outmoded scientific instruments and develop a systematic process for future replacement.
19. Improve facilities and provide adequate facilities maintenance for increasing program effectiveness.
20. Continue the development and updating of a long-range research plan.

RESEARCH IN PROGRESS

Supported by the Colorado Agricultural Experiment Station, CSU scientists are involved in literally hundreds of projects ranging from basic to applied research. Research results have been adapted to the needs of commercial agriculture with, in many cases, immediate benefit to producer and consumer alike. For example:

NEW PLANTS HOLD PROFITABILITY PROMISE

Colorado producers are looking for alternative crops that will profitably replace those either no longer profitable or no longer grown and that will fit into the crop rotation.

Colorado State University Agricultural Experiment Station researchers are studying 15 species of exotic plants at the various research centers, several of which show promise as profitable alternative crops for Colorado.

Quinoa (Chenopodium quinoa) appears to be a viable alternative crop for Colorado's high intermountain valleys. Sixteen cultivars were studied with yields of up to 30 bushels per acre.

Amaranth (Amaranthus cruentus) is well adapted to cultivated areas in the state's Eastern Plains. Yields at the CSU research centers averaged around 1,500 pounds per acre.

One hundred crambe (Crambe abyssinica) entries were evaluated in Fort Collins, and 15 will be advanced to yield trials. Crambe produces an inedible industrial oil which is in demand.

Sesame (Sesamun indicum) and rapeseed (Bassica napus) trials involved 232 sesame lines and one cultivar of rapeseed. Both species produced economic yields under one irrigation plus rainfall. Sesame appears well suited for the hot, dry areas of southeastern Colorado. Rapeseed is better suited for areas of adequate moisture.

SCIENTISTS HARVEST CLOUDS IN SEARCH OF

ELUSIVE ERWINIA CAROTOVORA BACTERIUM

New research by Colorado State University scientists has cracked the mystery of how supposedly healthy potatoes become infected with a disease that annually causes \$100 million in crop losses worldwide.

The research has shown the bacterium Erwinia carotovora appears to be transported to Western potato fields by clouds from the Pacific Ocean.

Researchers tracked Erwinia bacteria in rainfall and snow in Oregon and Utah and found it apparently moved in clouds at least as far as Colorado. Erwinia was located in the mountain snowpack and in the Yampa, Elk, Rio Grande, Arkansas and South Platte rivers.

Once deposited in precipitation, the bacteria can enter the soil directly or fall into waterways used for irrigation. Under certain conditions, a single bacterium can multiply by 200 million times in a day and infect potatoes specifically grown to be disease free.

Erwinia carotovora causes "soft rot" and "black leg" in potatoes and also infects other vegetable crops. In Colorado, the bacterium is the worst predator for the potato industry, which annually produces 1.7 billion pounds of potatoes. Losses due to Erwinia amount to 10 to 15 percent of the state's annual \$60-million potato crop.

WHEAT BREEDERS DEVELOP HIGHER-YIELDING SPRING AND WINTER WHEAT

Several thousand lines of winter and spring wheats were evaluated as part of the ongoing wheat-development program. More acres of wheat are planted and harvested in Colorado than all other field crops combined.

A new, medium-height, hard red, winter wheat--Carson--was released in August. It is higher yielding and earlier maturing than Sandy, currently the

premier wheat in Colorado, and has better seedling emergence under adverse conditions. It also is equal or superior to Sandy in all measures of milling and baking quality.

Agricultural Experiment Station researchers also released a new biscuit wheat--soft white spring wheat. Blanca has at least a 10-percent higher grain yield and less lodging than Owens, the current highest-yielding variety in the state.

Historically, white wheat flour was shipped into Colorado from the West Coast. When shipping costs nearly priced the white wheat flour industry out of the Colorado market, CSU's Agricultural Experiment Station was asked for help. Out of this contact white wheat production has grown to more than 2.5 million bushels per year. In addition, the production of crackers, cakes and cookies in Colorado has more than doubled.

NEW MARKET FOR MEAT OPENED BY RESTRUCTURED BEEF DEVELOPMENT

A raw meat binding process developed by Colorado State University researchers, funded in part by the Agricultural Experiment Station, permits the manufacturing of fresh meat into size, shape and quality demanded by a particular market.

The binding material is one that has been fully approved by the Food and Drug Administration. The binding material makes up less than 1 percent of the product and contains no sodium chloride (table salt) or phosphate salts. The finished product can be marketed in the raw refrigerated state.

The process involves working with the raw meat, which can be put into any desired shape. The process allows the processor to maintain precise portion control. The restructured meat can be battered, breaded, put in a barbecue or gravy sauce, pre-grilled or pre-fried, put in a pouch or used in any other way imagined.

No trim waste exists in the restructured product, and lean and fat content can be precisely controlled. Since exact standards can be set and achieved, products can be made for any specific market segment.

ETHANOL FROM SWEET SORGHUM 30-PERCENT CHEAPER

Plans to phase out the use of lead additives in gasoline should energize the domestic ethanol market, putting additional pressure on researchers to develop more efficient ways to produce ethanol alcohol.

Agricultural Experiment Station researchers have found a way to produce ethanol from sweet sorghum that will prove to be 30-percent cheaper than practices commonly used.

Sweet-stalk forage sorghum was studied because of its potential for bioconversion to fuel alcohols. The forage was harvested, chopped and cellulytic enzymes were added prior to ensiling. Ensiling acted as a pretreatment for lignocellulose bioconversion. In situ cellulose hydrolysis during storage of sweet sorghum by ensiling contributed to favorable economics for conversion of sweet sorghum to alcohol or chemical feedstocks.

Simplification of the preprocessing operations eliminated capital equipment for enzyme hydrolysis and recovery. Preliminary process design of an in situ process showed greater than 60 percent return-on-investment before tax for a plant producing 10 million gallons anhydrous ethanol per year compared to 10 percent return-on-investment for conventional means of bioconversion of sweet sorghum after ensiling without in situ cellulose hydrolysis.

IRM PROGRAM TAKES INTERDISCIPLINARY APPROACH TO RANCH PROBLEMS

No pat answers exist to any ranching problem. Every ranch is different-- different assets, liabilities, land resources, human resources, emotional

requirements and family dynamics. Colorado State University's Integrated Reproduction Management program is an attempt to pull together the University's many disciplines to help solve problems associated with ranching.

Disciplines on the IRM team include reproduction physiology, range management, agricultural economics, animal science and veterinary science.

The goal of the IRM program is to increase the pounds of calf produced per ranch by 10 percent within five years in a financially beneficial way.

Progress has been made in a number of areas on all ranches. In one case, the calving season has been reduced from 180 days to 100 days, and in another a copper deficiency was detected and corrected. On a third ranch, losses of newborn calves to scours was almost eliminated.

A computer program was developed to determine optimal calving time for ranchers in Colorado. Based on data obtained from IRM cooperators, calving later in the spring, closer to the onset of natural feed-stuffs, seems the most desirable based on profitability.

SUMMARY

The above examples describe only a few of the projects which are under investigation. Research continues in other areas to maintain the economic stability of agriculture in Colorado.

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It is not possible to name factors which are currently being investigated. It is not possible to name factors which are currently being investigated.

THESE ARE THE MAIN RESEARCH AREAS OF THE RRM PROGRAM.

COLORADO AGRICULTURAL EXPERIMENT STATION
RESEARCH DEPARTMENTS

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Agricultural and Natural Resource Economics

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Edward J. Langin, Superintendent (Agronomy)

Southwestern Colorado Research Center, Yellow Jacket
Adrian G. Fisher, Superintendent (Agronomy)

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PUBLICATIONS
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Lowell Sonnenberg
 Don Mais
 Wayne Foster
 Loren Good
 Bruce Lindahl
 Ed Cecil
 James Donnelly
 Warren McCue
 Mark Wagers
 Ronald Boyd

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Orchard Mesa Research Center, Grand Junction

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Dean Phillips
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ANNUAL REPORT 1985

AGRICULTURAL SCIENCES

AGRONOMY

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COLORADO AGRICULTURAL EXPERIMENT STATION
STATEMENT OF REVENUES AND EXPENDITURES

	<u>1984-85 Actual</u>	<u>1985-86 Budget Estimate^{1/}</u>
Revenue:		
State General Fund	\$6,683,225	\$6,544,435
Federal Appropriations	1,437,918	1,488,463
Cash Sales	<u>241,835</u>	<u>240,000</u>
Total	\$8,462,978	\$8,272,896
Expenditures:		
Administration - Director's Office	\$ 216,012	\$ 220,736
Program	7,036,285	6,820,228
Utilities	326,454	340,144
CSU Plant and Administration	<u>884,227</u>	<u>891,788</u>
Total	\$8,462,978	\$8,272,896

^{1/}After reduction for State General Fund recision and Gramm Rudman Hollings Act reductions.

PRIORITY BUDGET NEEDS FOR 1986-1987

Critical needs are for personnel, operating and equipment support to maintain and strengthen research programs in agricultural marketing, finance, credit and policy; production and marketing of new and alternative crops; integrated reproduction management; integrated pest management; integrated soil and crop production and marketing systems; and socio-economic factors influencing individuals, families, communities and overall consumer needs.

BUDGET REQUEST

	AMOUNT	FTE
1986-1987 General Fund Request		
Base Program	\$5,805,037	124.6
AES Administration and Program Increase:		
Personnel	359,411	11.3
Travel	57,614	
Operating	343,882	
Capital Outlay	155,016	
Total Program Increase	915,923	11.3
Utilities	419,036	
Admin. and Physical Plant	1,282,505	36.5
Total 1986-1987 Request	\$8,422,501	172.4

Budget Summary

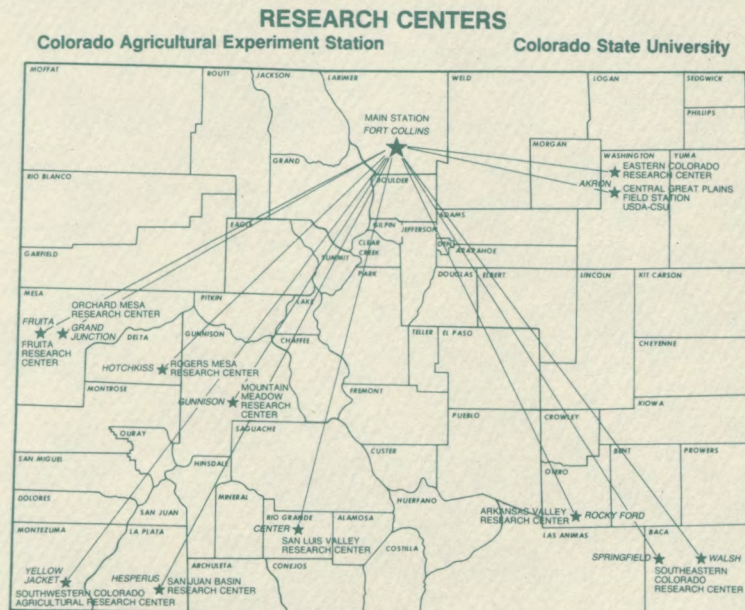
Source of Funds	1985-86 Base	1986-87 Request	Increase (Decrease)	%Increase (Decrease)
General Fund	\$6,690,885	\$8,422,501	\$1,731,616	25.9
Nonappropriated Funds				
Federal Funds	\$1,557,625	\$1,557,625	-0-	-0-
Cash Funds	240,000	240,000	-0-	-0-
Total	\$8,485,510	\$10,220,126	\$1,731,616	

Of the requested increase, \$915,923 is to restore resources lost over the past years. The request for support of integrated systems includes improving the Colorado Agricultural Experiment Station's ability to increase research in biotechnology and other areas of new technology and to strengthen and enhance its statewide research program.

Colorado agriculture must be competitive on a national and international basis. Research can play a major role in improving the competitive position of Colorado agriculture and in developing an economically stable agriculture.

1985-86 FIELD DAY SCHEDULE
 Agricultural Research Centers
 Agricultural Experiment Station
 Colorado State University

1985		1986	
April 27	CSU Livestock Pavilion, 1:30 p.m. Annual CSU Bull Sale.	April 5	Eastern Colorado Research Center, Akron, 1:00 p.m. Open house and view cattle.
May 21	Eastern Colorado Research Center, Akron, 10:00 a.m. - 4:00 p.m. View cattle and facilities; noon lunch and afternoon program.	April 12	Eastern Colorado Research Center, Akron, 11:30 a.m. Northeast Colorado Bull Test Sale.
July 10	Orchard Mesa Research Center, Grand Junction, 4:00 p.m. Orchard Management and Fruit Research Program.	April 20	San Juan Basin Research Center, Hesperus, 1:00 p.m. Open house and view cattle.
August 1	Fruita Research Center, Grand Junction, 4:00 p.m. Review of current research on irrigation and tillage practices, variety evaluations and maximum yields.	April 21	San Juan Basin Research Center, Hesperus, 12:00 noon. Four Corners Bull Test Sale.
August 23	CSU Bay Farm Research Facility, Fort Collins, 2:00-5:00 p.m. Review of research in Plant Pathology/Weed Science, Entomology and Botany.	May 20	Eastern Colorado Research Center, Akron, 10:00 a.m. - 4:00 p.m. View cattle and facilities; noon lunch and afternoon program.
August 27	Agronomy Research Center, Fort Collins, 5:00 p.m. Review of research on forage crops, corn, sorghum, millets, dry beans, soybeans, sugarbeets and alternative crops.	June 12	Mountain Meadow Research Center, Gunnison, 1:30 p.m. Agronomy research.
August 29	Southeastern Colorado Research Center with Plainsman Agri-Search Foundation, Walsh, 12:00 noon. Open house and review of ongoing research.	July 17	Rogers Mesa Research Center, Hotchkiss, 10:00 a.m. Orchard management and fruit research program.
		August 8	San Luis Valley Research Center, Center, 8:30 a.m. Irrigated crops research.
		August 28	Southeastern Colorado Research Center with Plainsman Agri-Search Foundation, Walsh, 12:00 noon. Open house and review of ongoing research.
		Sept. 10	Arkansas Valley Research Center, Rocky Ford. Time to be announced. Field crop research.



Colorado State University
Agricultural Experiment Station
Fort Collins, Colorado 80523

R. D. Heil, Director

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