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1986 Annual Report

Agricultural Experiment Station

Colorado State University, Fort Collins, Colorado 80523

Colorado State University

Philip E. Austin, President
Albert J. Linck, Provost

Agricultural Experiment Station

Robert D. Heil, Director
Helen F. McHugh, Deputy Director
Frank P. Johnson, Assistant to Director
Mary Ann Sanchez, Senior Secretary
Jennifer Rockwell, Information Processing Equipment Operator

University Support Staff

Louis E. Stephenson, Editor
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From the Director

The Colorado General Assembly enacted legislation in 1888 to establish the Colorado Agricultural Experiment Station. This legislation created for Colorado a federal-state partnership in agricultural research that evolved from action of the United States Congress the preceding year when the Hatch Act was passed. So this year we celebrate the 100th anniversary of federal legislation significant to agricultural research as we bring down the curtain on the first hundred years of research conducted by the Colorado Agricultural Experiment Station.

This station's contributions to Colorado agriculture cover a variety of factors associated with the production, processing, and marketing of agricultural products. Not only has the station's program included studies on the myriad of factors associated with commodities but also studies have dealt with the management of the human and natural resource base on which agriculture depends.

This year's annual report, as in previous years, represents the information that has been generated by research scientists supported by the Agricultural Experiment Station. Publication of research results in various forms is the major avenue for getting new information into the hands of people for their decision-making.

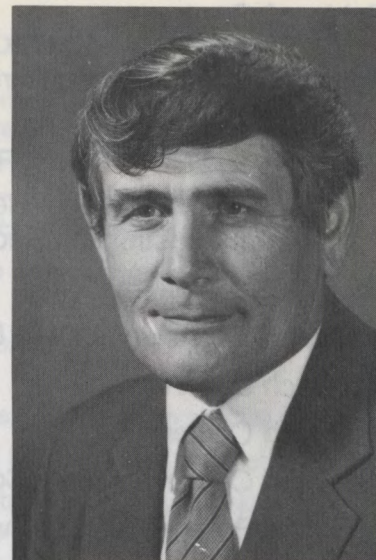
The introductory portion of this report reflects the integrated programmatic relationships among the research efforts. I am happy to report that research efforts are being developed based not only on priorities but also with scientists from several disciplines working together to meet the research needs of Colorado agriculture. I am very pleased with the commitment of the scientists to this approach as it allows for more efficient use of resources and, equally important, provides understanding of the interrelationships among the physical, biological and socio-economic factors that make up an agricultural system.

Understanding interrelationships that affect the economic viability of agricultural systems is more critical today than ever before, given the complexity of factors confronting agriculture. Never before has agriculture faced so many issues. These impact every phase of the agricultural system from production through marketing and consumption of agricultural products. The commitment of the Agricultural Experiment Station is to continue developing our research program in a direction that allows Colorado agriculture to function in a rapidly changing economic and technological environment.

Our goal is to conduct research that promises to improve the profitability of farming, ranching, and agricultural industries. The station's program includes research to improve food product quality, to solve problems related to the natural resources associated with agriculture, and to enhance the economic stability of rural Colorado. Researchers are working to keep Colorado competitive in national and international markets.

Colorado's Agricultural Experiment Station has had an illustrious first century. We look optimistically to a bright future of service to the state. We are planning a series of events to begin in 1988 to celebrate this station's one hundred years as an integral part of the federal-state partnership for agricultural research. We hope you will be able to participate in these activities.

The Agricultural Experiment Station is a publicly supported state research program as part of Colorado State University, and your comments regarding our program and this report are welcomed and solicited.



R.D. Heil, Director
Agricultural Experiment Station

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Understanding interrelationships that affect the economic viability of agricultural systems is more critical today than ever before, given the complexity of factors concerning agriculture. However, before we can address such many issues, these impact every phase of the agricultural system from production through marketing and consumption of agricultural products. The commitment of the Agricultural Experiment Station is to continue developing our research program in a direction that allows Colorado agriculture to function in a rapidly changing economic and technological environment.

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The Agricultural Experiment Station is a publicly supported state research program as part of Colorado State University, and your comments regarding our program and this report are welcomed and solicited.

Colorado State University and the Agricultural Experiment Station are equal opportunity institutions. We do not discriminate on the basis of race, sex, or ethnicity in our educational programs, activities, or employment. For more information, contact the Office of Equal Opportunity, 1475 Campus Drive, Fort Collins, CO 80523, (970) 491-3111.

Planning for Future Agricultural Research in Colorado

Background

In our 1985 Annual Report, we reported our long-range planning to guide on-going research of the Agricultural Experiment Station. In the planning process, 20 major long-term research and research-management goals were identified. These goals continue to be refined and objectives corresponding to those goals are being developed.

Challenges

Technologies that producers need to remain competitive are costly and complex. The research and education community must develop programs focused on a broad objective of increasing profitability to help producers deal with problems associated with a depressed agricultural economy. To remain competitive, modern agriculture must maintain a cadre of highly qualified scientists and professionals with resources to continue research efforts in a wide range of multi-disciplinary effort.

Transfer of technical information for decision-making will require development of information networks between sources of information and users such as producers and markets and the maintenance of a technology base to support the information network.

Critical to research, extension and education program direction is an examination of factors influencing the global, domestic, and Colorado agricultural economy. This examination is an on-going process. Many questions and assumptions influence future direction of the Colorado Agricultural Experiment Station research. The following are some questions and assumptions from which we have developed plans for new research initiatives.

Questions and Assumptions Which are Critical to the Future of Agriculture

Further assessment is necessary to attain the broad objective. Agriculture is influenced by the global economy, technology, the natural resource base, and demand for its products as well as other externalities.

One of the main factors affecting agriculture today is the global economy in which we compete. Following are several questions which relate to the global situation. Can we assume that:

- recent increases in the food supply will continue? Can food production increases which we have seen in developing countries be sustained?
- the food and fiber needs of approximately 250 million new people being added to our globe each year will be met?
- the "greenhouse effect" will not dramatically alter climates of the world?
- underdeveloped and developing nations will be able to service their current large debt in the near future and again resume economic growth and development?
- policies which affect agriculture, both nationally and internationally, will be developed to stabilize the agricultural industry?

With respect to domestic production technology and resources, products and profitability, future research will be influenced by the following. Can we assume:

- that an agricultural production system heavily dependent on chemical inputs will be continued?
- an adequate "human resource base" remains in agriculture?
- an adequate capital base is available to serve agriculture?
- that new technologies will strengthen agriculture?
- that interest rates will become lower and stabilize?
- a stable and reasonable cost energy supply exists?
- that the quality of our national resource base will be sustained without greater inputs?
- that existing soil losses due to erosion will not degrade the production potential of our land?
- there is an adequate quantity and quality of our water supplies?
- that need for and abilities to transfer technology will be increased?
- that the products of agriculture can respond to the dietary preference of people?
- that new uses for agricultural products particularly non-food can be developed?

And in addition, certain questions directly affect research on Colorado agriculture. Can we assume that:

- opportunities for diversifying the economy of rural Colorado can be found?
- Colorado's population will continue to grow?
- Asia and the Pacific Rim will develop as major trading partners for Colorado?
- Colorado's agriculture and food processing sectors can be stabilized and enhanced?

The questions raised are by no means meant to be comprehensive. What they do is identify the complexity of the situation we face in agriculture now and for the foreseeable future.

These considerations led us to developing initiatives important to maintaining a viable Colorado agricultural industry. This economy includes five important sectors: farm inputs (seed, feed, pesticides, fertilizer, equipment); farm production; food manufacturing and distribution; food retailing; and, restaurant and catering trades. These sectors account for approximately \$16 billion in gross receipts annually.

The research programs of the Colorado Agricultural Experiment Station emphasize base programs in plant and animal breeding; diseases and pests; value-added products; and development of markets for Colorado producers. These programs require a multi-disciplinary systems approach aimed at optimizing profit through integration of management, production and marketing.

Emerging Research Priorities

Giving consideration to the questions and possible assumptions, it is clear that the Colorado Agricultural Experiment Station must direct research into four important areas. However, in maintaining its base of research, it is also clear that new additional funding must be received to develop the potential offered by this new research. Our 1987-88 legislative budget request addressed the following new initiatives for funding:

1. Production, Processing, and Marketing of New and Alternative Crops. Plants native to Eastern Europe, Africa, and South America are a potential diversification of Colorado agriculture if adaptable to Colorado environment conditions, including arid conditions on the eastern plain and growing conditions in high altitude locations, and if suitable for commercial production. Potential crops are sources of food and non-food (industrial oils) products.

Research objectives include determining adaptability, breeding, disease resistance, processing characteristics and systems and identifying and developing specialty markets. Marketing presents a unique problem, because such crops are grown under contract rather than sold in large developed markets. Nutritional quality and product development are extremely important aspects to be researched with respect to differentiating potential products from other alternatives. Certain crops may be marketed to the health food industry which is experiencing a high growth rate.

Certain regions of Colorado historically have grown major commodities, such as wheat and corn, because soil and environmental conditions dictate the type of crops which can be grown. Deteriorating crop prices due to surpluses and competitive markets require commodity diversification.

New and alternative crops, if adaptable, will be complementary to existing crops because cultural practices (planting, fertilization, harvesting, etc.) will not require materially different equipment or techniques. However, it should be noted that acreage for these new and alternative crops are not substitutes for acreage of existing crops because potential markets as known today are not large enough to absorb production at levels of existing crops.

If research proves successful, certain crops may have potential for export from Colorado as well as for developing a processing industry in Colorado for specialty crops. The end result expected is to increase producer profitability and to broaden the agricultural industry in processing and marketing opportunities.

2. Integrated Crop and Livestock Systems to Improve Economic Efficiency and Profitability. The systems approach is a new technology facilitated by the development of computers that provides the means for integrating single discipline research results on agricultural production, processing and marketing into systems that optimize economic return and resource management.

This research will be directed toward finding optimum combinations of crops, fertilizers, water management, pest control, and marketing and processing strategies for the agricultural systems of Colorado. Further, livestock management research which has been initiated through the Integrated Reproduction Management program will be extended to livestock other than beef cattle. The systems approach assists in determining a balance between cropping and livestock systems for developing management strategies from which farmers and producers realize profits.

Modern technologies as well as a rapidly changing economic environment have made agriculture so complex that evaluating management strategies by trial and error is impractical. The use of computer models and expert systems technology appears to be a feasible solution, however, such systems and data must be developed. To predict which of the available technologies offer the greatest promise of success, we must test them using a systematic approach. As single discipline research is used to solve a specific problem, the solution can be entered into the model to determine the impact on other factors influencing profitability.

3. Application of Biotechnology to Improve Agricultural Economy and Enhance Environment.

Biotechnology applications to agriculture hold promise for genetic improvements in livestock and crops to reduce susceptibility to disease, to improve reproduction processes, and to develop new crops.

The focus of the research will be:

- to utilize principles of biotechnology in the development of improved methods for increasing resistance of plants and animals to diseases, insects and other pests.
- to utilize biotechnology in fermentation and other processes to enhance "value-added" potential of Colorado grown agricultural products.
- to improve animal resistance to environmental stress.
- to improve drought resistance of food and fiber crops.
- to develop improved methods for germplasm maintenance so crucial to our basic livelihood.

Current developments and application of biotechnology are focused nationally on human biological science applications. Colorado State University has the largest collection of programs in biology among Colorado higher education institutions. These biology programs are primarily directed toward animal and plants. Certain biotechnology applications already have given Colorado State University a preeminence in animal biotechnology through cloning techniques. The applications of biotechnology to plant sciences is undeveloped. The AES mission (to support the Colorado agricultural industry) dictates that research capability be developed to address plant and animal biotechnology possibilities. However, the research expertise and facilities and equipment to conduct biotechnology research are inadequate and must therefore be developed.

4. Development of Economic Alternatives to Diversify Existing Crop and Livestock Operations.

The market base for existing agricultural products must be broadened by developing alternative uses of existing products, seeking alternative markets, developing processing capability within Colorado for alternative uses, and examining potential diversification of farmer and producer revenues in such areas as incorporating tourist activities (hunting, fishing, dude ranching) with existing operations.

The thrust of this research is to:

- determine alternative uses of existing field and fruit crops, and livestock products and diversify use of agricultural lands and facilities.
- develop alternative markets by ascertaining market niches to be exploited.
- determine viability of new processing plants for adding value to Colorado crop and livestock products.

By broadening markets and processing capability, the base of agricultural economic activity can be strengthened which can increase returns to individuals and in turn improve state revenues. Blending agricultural with non-agricultural operations reduces sensitivity to fluctuations in agricultural market prices and diversifies revenues.

Summary

The Agricultural Experiment Station is uniquely positioned to meet the challenge of increasing profitability in agriculture. By raising critical questions, we believe the research direction and new initiatives will go a long way in meeting the challenge. Your support and input has been and will continue to be valued in meeting our common objective — increasing profitability in Colorado agriculture.

| Amount | FTE | |
|----------------|-----|------------------------------------|
| \$8,012,170.5 | | Total General Fund Request |
| 883,707.38 | | Physical Plant |
| | | General Administration and |
| | | Colorado State University |
| | | Utilities |
| 435,888 | | AES Administration Request |
| \$8,580,915.12 | | Total Research Program and |
| 88,803.23 | | Crop and Livestock Operations |
| | | Alternatives to Diversify Existing |
| | | Development of Economic |
| | | Enhance Environment |
| 172,255.28 | | Improve Agricultural Economy and |
| | | Application of Biotechnology to |
| | | Efficiency and Profitability |
| 238,048.80 | | Systems to Improve Economic |
| | | Integrated Crop and Livestock |
| | | Crops |
| 68,518.18 | | Marketing of New and Alternative |
| | | Production, Processing, and |
| | | Emerging Research Initiatives |
| \$5,995,299.12 | | Program Base for 1987-88 |
| 391,125 | | plus: inflation increases |
| \$6,386,424.12 | | 1988-89 Research and AES |

Colorado Agricultural Experiment Station 1988-89 Legislative Budget Request

General Fund Budget Request

| | Amount | FTE |
|--|--------------------|--------------|
| 1986-87 Research and AES Administration | \$5,604,164 | 121.3 |
| plus: inflation increases | 391,125 | |
| equals: Program Base for 1987-88 | \$5,995,289 | 121.3 |
| plus: Emerging Research Initiatives: | | |
| • Production, Processing, and Marketing of New and Alternative Crops | 88,518 | 1.6 |
| • Integrated Crop and Livestock Systems to Improve Economic Efficiency and Profitability | 236,048 | 6.0 |
| • Application of Biotechnology to Improve Agricultural Economy and Enhance Environment | 172,255 | 2.8 |
| • Development of Economic Alternatives to Diversify Existing Crop and Livestock Operations | 88,803 | 2.3 |
| equals: Total Research Program and AES Administration Request | \$6,580,913 | 134.0 |
| plus: Utilities | 435,598 | |
| Colorado State University General Administration and Physical Plant | 993,707 | 36.5 |
| Total General Fund Request | \$8,010,218 | 170.5 |

Capital Construction Request

The highest priority in the AES capital construction request is the development of the North Agricultural Campus to replace existing lands near the Colorado State University campus. Leases of lands used for research, extension and instruction are expiring in January, 1988 and cannot be renewed. Additionally, other lands are being impacted by nearby commercial development and long-term research cannot be conducted.

The North Agricultural Campus is planned to be an integrated multidisciplinary state-of-the-art research, extension and instruction field facility for plant, soil, water, and animal sciences. The principal benefits associated with this facility and which distinguish the facility from out-state research centers are:

- Serving as a field site to pilot test new research findings developed in on-campus laboratories, greenhouses and growth chambers.
- Developing research methodology and procedures and base data for further testing on site-specific environments at other locations and for determining if results are consistent with initial observations.
- Providing home location for long term breeding nursery for major grains, legumes and germplasm.
- Developing research methodology for addressing agricultural chemicals mobility and transformation over time.
- Providing environmental site characteristics which model northeast Colorado.

The 1987-88 request incorporates Phase I of the project.

Phase I. \$1,124,600

Land preparation including land leveling, installing irrigation systems, roadways and retention ponds.

Colorado Agricultural Experiment Station
Statement of Revenues and Expenditures

| | 1985-86 Actual | 1986-87 Budget Estimate ¹ |
|---|--------------------|---|
| Revenue: | | |
| State General Fund | \$6,549,958 | \$6,805,367 |
| Federal Appropriations | 1,500,531 | 1,500,531 |
| Cash Sales | 240,000 | 240,000 |
| Total | \$8,290,489 | \$8,545,898 |
| Expenditures: | | |
| Administration — Director's Office | \$ 220,736 | \$ 227,348 |
| Program | 6,837,821 | 6,992,486 |
| Utilities | 340,144 | 394,123 |
| Colorado State University Plant and Administration | | 931,961 |
| Total | \$8,290,489 | \$8,545,898 |

Supplemental Information

¹After reduction for State General Fund rescission.

Colorado Agricultural Experiment Station Statement of Revenues and Expenditures

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| | \$8,290,489 | \$8,545,898 |

¹After reduction for State General Fund recision.

Colorado Agricultural Experiment Station
Statement of Revenue and Expenditures

1988-89 Budget
Estimate¹

1987-88
Actual

Revenue:

State General Fund
Federal Appropriations
Cash Sales

\$6,805,387
1,500,531
240,000

\$6,549,928
1,500,531
240,000

Total

\$8,545,918

\$8,290,459

Expenditures:

Administration — Director's Office
Program
Utilities
Colorado State University
Plant and Administration

\$ 227,348
6,992,488
394,123

\$ 220,738
6,937,821
340,144

Total

931,961

891,788

\$8,545,918

\$8,290,459

¹After reduction for State General Fund reduction.

COLORADO AGRICULTURAL EXPERIMENT STATION
RESEARCH DEPARTMENTS

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Bruce Lindahl
Gilbert Lindstrom
Warrn McCue
Don Mais
Milton Mekelburg
Rob Pachner
Lowell Sonnenberg
Jay Spiers
Mark Wagers
Rick Zion

Agricultural Experiment Station
 Technical Bulletins and Technical Reports

Technical Bulletins

| | | | |
|---------|---|----------------------------------|---------------------|
| TB-86-1 | Contingent Value Estimates for Increments of Federal Grazing | McKean, Hoff Bartlett, Taylor | ANRE, Range Sci. |
| TB-86-2 | Liquid Sludge Incorporation and Nitrogen Availability to Dryland Winter Wheat | Barbarick, Utschig Westfall | Agronomy |

TB-L

| | | | |
|-----------|---|-------------|-----------------------|
| TB-L-86-1 | Atrazine Management Within a Winter Wheat Corn-Fallow Rotation (Anderson) | Anderson | Agronomy USDA-CGPS |
| TB-L-86-2 | Economics of Fed Beef Production in Colorado | Madsen, Gee | ANRE |

Technical Reports

| | | | |
|---------|--|--|------------------------------|
| TR-86-1 | Performance Test of Corn Hybrid and Soy Bean Variety in Colorado 1985 | Echols | Agronomy |
| TR-86-2 | Sorghum Hybrid Performance Tests in Colorado, 1985. | Youngman, Langin Shanahan, Schweissing | Agronomy, SECRCs, AVRC |
| TR-86-3 | Performance of Greenbug - Resistant Sorghum Hybrids in Arkansas Valley | Youngman | Agronomy |
| TR-86-4 | Response of Onions to Seven Irrigation Levels | Crews, Ells | Hort., A&CE, ARS |
| TR-86-5 | 37th Annual Beef Cattle Improvement Report and Sale Data | Brinks | Animal Sciences |
| TR-86-6 | Climatological Observations at the Southeastern Colorado Research Center 1957-1985 | Peel | Range Sci. SECRCs |
| TR-86-7 | Peach Orchard Management | Yu, Roygoyski, Renquist | Hort., RMRC, OMRC |
| TR-86-8 | Fall and Spring Nitrogen Fertilization of Dryland Winter Wheat | Russell, Westfall Barbarick | Agronomy |
| TR-86-9 | Application of Anaerobically Digested Sewage Sludge to Dryland Wheat | Barbarick, Westfall, Follett | Agronomy |

| | | | |
|----------|--|--------------------------|------------------|
| TR-86-10 | The Effect of Respond on Corn Grain Yields | Clark, Shanahan | Agronomy |
| TR-86-11 | Sulfonylurea Herbicide Tech.: Comparative Tolerance of No-Till Grain Sorghum, Proso Millet, and Winter Wheat to Soil-Applied Chlorsulfuron (Glean) and its Relation to Recropping Interval | Sutherland | Agronomy SECR |
| TR-86-12 | Sulfur Fertilization of Dryland Winter Wheat | Follett, Vaughn, Russell | Agronomy |

- A & CE - Agricultural and Chemical Engineering
- ANRE - Agricultural and Natural Resource Economics
- ARS - Agricultural Research Service
- AVRC - Arkansas Valley Research Center
- OMRC - Orchard Mesa Research Center
- RMRC - Rogers Mesa Research Center
- SECRCS - Southeastern Colorado Research Center at Springfield
- SECROW - Southeastern Colorado Research Center at Walsh
- USDA-CGPS - USDA Central Great Plains Station

Technical Reports

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| TR-86-1 | Performance Test of Corn Hybrid and Soy Bean Variety in Colorado 1985 | | |
| TR-86-2 | Sorghum Hybrid Performance Tests in Colorado, 1985 | Youngman, Langin, Shanahan, Schweissing | |
| TR-86-3 | Performance of Resistant Sorghum Hybrids in Arkansas Valley | Youngman | |
| TR-86-4 | Response of Onions to Seven Irrigation Levels | Crews, Ellis | |
| TR-86-5 | 37th Annual Beef Cattle Improvement Report and Sale Data | Beines | |
| TR-86-6 | Climatological Observations at the Southeastern Colorado Research Center 1985-1986 | Fool | |
| TR-86-7 | Beach Orchard Weevils | Yu, Hoyovskii, Hanzlik | |
| TR-86-8 | Fall and Spring Nitrogen Fertilization of Dryland Winter Wheat | Russell, Westfall, Gerberick | |
| TR-86-9 | Application of Anaerobically Dugested Sewage Sludge to Dryland Wheat | Gerberick, Westfall, Follett | |

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