Mapping the Future
Genome to GIS
Research Highlights 2000-2001

New Mexico State University
Agricultural Experiment Station

SATELLITE IMAGE COURTESY OF CARSPACE
Mission of New Mexico State University's Agricultural Experiment Station

NMSU's Agricultural Experiment Station supports fundamental and applied science and technology research to benefit New Mexico's citizens in the economic, social and cultural aspects of agriculture, natural resources management and family issues.

Description of the Agricultural Experiment Station

The Agricultural Experiment Station is the research component of NMSU's College of Agriculture and Home Economics. It is a system consisting of scientists on NMSU's main campus and at agricultural science centers throughout New Mexico. The off-campus centers support fundamental and applied research under New Mexico's varied environmental conditions to meet the agricultural and natural resource management needs of communities in every part of the state.

The Agricultural Experiment Station solicits and receives stakeholder input from many sources, including advisory boards of local farmers or ranchers, business people and interested citizens who identify issues needing research.
New Mexico State University’s Agricultural Experiment Station is one of the largest research organizations in the state. The Experiment Station’s activities extend across the state to address issues of importance to the people of New Mexico. Working with our colleagues in the Cooperative Extension Service, we bring science to your lives.

The Experiment Station is one of the best investments the State of New Mexico makes. Tax money invested in the Experiment Station is matched by federal “formula funds” and an increasing number of grants, contracts, and gifts. For every state dollar invested in the Experiment Station, we attract more than a dollar in additional research and academic scholarship funding. The results of our research contribute to the economy of New Mexico and affect the lives of its citizens.

The Experiment Station was rated as one of only five research and public service programs to exceed expectations among 38 assessed in 2001 by the New Mexico Commission on Higher Education. As such, it is a “Tier I” program.

This report is part of an accountability process responding to input from consumers and stakeholders. It provides an overview of our research activities. More detailed descriptions of research performed by Experiment Station scientists are contained in New Mexico Resource Returns, the College of Agriculture and Home Economics’ project impact database available on the World Wide Web at aces.nmsu.edu/nmr.

Research often is considered either “basic” or “applied.” Basic research asks fundamental questions about how things work; applied research searches for solutions to practical problems. Either type of research can involve a single scientific discipline or it can be multidisciplinary, engaging researchers from several fields. But good science is good science, regardless of whether the investigation is basic or applied in nature. This report presents examples of both kinds of research being conducted by Experiment Station scientists throughout the state.

A recurring theme in the research performed by Experiment Station scientists is sustainability—how to use our natural and human resources wisely and increase or conserve them so that they will be available for future generations. In New Mexico, sustainability means understanding and managing scarce resources, such as water and land, so that different uses of natural resources can coexist, and we can live harmoniously with each other in our “Land of Enchantment.” Experiment Station scientists are investigating all aspects of the sustainability issue, including cultural and economic.

We hope you find this sampling of research informative and useful. Please feel free to contact us if you have any suggestions for future research directions, or if you would like additional information about our activities.

Jerry G. Schickedanz
Dean and Chief Administrative Officer, College of Agriculture and Home Economics

I. Miley Gonzalez
Interim Vice Provost for Research, New Mexico State University

LeRoy A. Daugherty
Interim Director, Agricultural Experiment Station
New Mexico has a rich and diverse natural resource base that is arid, semiarid and, in many respects, extremely fragile. This resource base contributes greatly to the economic well-being of the state’s residents. Its economic uses result in demands for various resources. In addition to direct demands for land and water, there is increasing pressure for recreational activities that represent a growing economic opportunity.

The New Mexico economy depends heavily on agriculture, its related industries and tourism. Economic output from farmers and ranchers in 1999 was $2.1 billion. The tourism industry is the largest private sector employer and the second largest private sector industry in the state ($3.7 billion). Research on the sustainable use (management and protection) of our natural resource base is critical for the futures of all these industries.

Both rural and urban human activities can pollute land, water, air and food. Partnering with other universities, national laboratories, and state and federal agencies, the Experiment Station is committed to furthering our understanding of human impact on the environment and to supporting environmentally sound agricultural and natural resource practices.

Water Use Management

Water is the most important limiting resource for New Mexico. All aspects of water use affect agricultural efficiency and profitability. Good water quality and availability are critical for all agricultural and nonagricultural uses. Water management will become more critical as water demands for urbanization and industrialization increase. As water issues continue to grow, so must efforts to identify problems and find sustainable solutions for all water users in New Mexico. The Experiment Station conducts aggressive research on water issues, such as depletion rates, connections between surface and ground water, land use effects on ground and domestic water systems, and best management practices for water use.
Urban Impacts
Experiment Station scientists study water use efficiency, and nutrition and water quality characteristics for landscape trees and ornamental plants in urban environments. Preliminary results indicate which trees are drought-tolerant and appropriate for the arid Southwest. Other results suggest that some ornamentals have potential for limiting mineral nutrient runoff, nitrate leaching and wastewater purification.

Arid Lands Agriculture
Water shortages have led producers to reevaluate their farming and ranching practices. Researchers are comparing stand establishment and pasture composition using selected perennial forage legumes and various grazing regimes to try to maintain New Mexico agriculture in areas where water resources are scarce. Researchers also are investigating changes in native plant and animal populations in desert regions due to increasing human populations.

Forest Management and Water Quality
Experiment Station scientists are examining the effects of forest harvesting disposal on stream water runoff, sediment concentration and vegetation responses. Reduced soil erosion and improved stream water quantity and quality help preserve game fish and wildlife and provide more water for livestock, production agriculture and communities. Researchers also are developing techniques for growing various native woody plants. The results can be used to enhance reforestation, restoration, reclamation and revegetation efforts in New Mexico.

Biological Control and Integrated Pest Management
Experiment Station scientists are developing pest management tools for boll weevil, bollworm and beet armyworm that will protect cotton yields from insect pests in semiarid climates. As a result, U.S. cotton farmers may save more than $30 million per year until the weevil is eradicated. Researchers also are developing pest management techniques to suppress insect populations without insecticides, lowering farmers’ costs and reducing environmental impact.

Climatology, Desertification and Global Warming
Experiment Station researchers are able to estimate the amount of soil inorganic carbon in the drylands of the western United States. They also have calculated rates at which atmospheric carbon dioxide is being stored in soil and plants. Both values are needed to understand how to mitigate the greenhouse effect and desertification of our lands.

Public Lands Policy
The coordinated, multistate Policy Analysis Center for Western Public Lands provides the land-grant university system with a framework for increasing its involvement and educational role in public land policy. Experts in public land management from the ranching, state and federal agency, university and environmental communities (including scientists from NMSU’s Experiment Station) were surveyed about the future of public land grazing and factors that will influence grazing on public lands. Scientists contributed to a coordinated publication about public land policy issues, published as an NMSU research report.
Crop Plant Genetics

Drought is the most common and severe limitation of plant productivity. Plants that evolve in arid and semiarid areas develop a complex array of adaptations to survive. Experiment Station scientists have constructed libraries of drought-responsive genes and are using gene sequencing tools to locate and identify those genes that help plants adapt to arid environments. They use this approach with bulb onions and chile pepper breeding. Developing drought- and heat-resistant crop plants should help water conservation efforts. Disease- and pest-resistant crops require fewer pesticide applications. Higher quality crop products engineered for specialty uses also may contribute to reduced industrial pollution.

Competitive Onions

Plant breeders are developing low-pungency onion cultivars that mature at different times to ensure a continuous supply of mild onions from late May through mid-August. Two low pungency, yellow onions (NuMex Freedom and NuMex Arthur) were released in 2000. Two other disease-resistant cultivars (NuMex Chaco and NuMex Snowball) also were released. NuMex seedling cultivars were screened for resistance to Fusarium basal rot. Further development and release of high-yielding, high-quality, well-adapted onion cultivars with varying maturity dates and pungency levels will support industry growth in New Mexico.
Cotton Breeding
Researchers are working to improve Acala 1517 cotton for agronomic, fiber and pest resistance traits. In 2000, New Mexico growers produced approximately 100,000 bales of Acala 1517 cotton. A new cultivar, Acala 1517-99, produces 7 percent more cotton than other Acala cultivars, bringing a net gain of $3 million annually for New Mexico growers. All of the 1517 cotton sold in 2000 for approximately 10 cents per pound more than other cotton, adding more than $5 million in value to the crop.

Alfalfa Breeding
Alfalfa accounts for more than 30 percent of crop cash receipts in New Mexico ($189 million in 1999); only livestock and dairy products have greater cash receipts. Researchers are developing drought-tolerant cultivars that possess high levels of resistance to anthracnose, a serious fungal disease of stems, crowns and leaves. One such alfalfa germplasm was released in June 2000.

New Crops and New Uses
Experiment Station researchers are evaluating the nutritional needs of new ornamental crops in New Mexico and looking for new uses of crops. Research results will:

- allow scientists to devise methods to extend cut flower use without applying synthetic chemicals
- allow for more efficient use of greenhouse-applied fertilizers, minimizing nutrient runoff and increasing crop water use efficiency
- minimize nitrate leaching into groundwater supplies
- allow fast-growing trees to serve as a low-input, natural wastewater purification system for communities along the U.S./Mexico border

Plant Health
Experiment Station scientists are working to prevent soil-borne disease in irrigated agriculture. They are developing chile cultivars with improved levels of Phytophthora root rot and foliar blight tolerance. Highly disease-resistant chile cultivars require less fungicide, reducing the risk of the chemicals leaching into the water table. In New Mexico, about 25,000 acres of chiles could benefit.
Locoweed Poisoning

Experiment Station researchers are studying how the toxin in
locoweed (swainsonine) affects cattle. They have found that
while swainsonine rapidly clears milk, it does affect milk pro-
duction. Determining how sensitive cattle are to swainsonine
sensitivity aid in developing management strategies to
improve the animals' tolerance to locoweed. Better under-
standing about how nutrients interact with plant toxins will
help researchers improve animal performance on rangelands
with appropriate supplements when poisonous plants are
prevalent.

Feedlot Health

Researchers are investigating the health and performance of
northern New Mexico calves as part of a feedlot health study.
Two experiments were conducted to find out how giving
highly stressed, newly received cattle dietary vitamin E sup-

plements affects their performance, health and immune response. Data collected during the feedlot studies should help producers optimize the health performance of range cattle in the West, while improving the income and sustainability of family ranches.

Cattle Production Efficiency

Experiment Station researchers are investigating genetic mechanisms that regulate growth and reproductive functions to improve beef cattle production in semiarid climates. If cattle become more efficient in using the nutrition in rangeland plants, the grazing pressure on sensitive desert rangelands could be reduced.

Sheep Production Efficiency

Experiment Station researchers are developing a nutrition program that will increase reproductive output of ewes grazing native rangelands. If scientists can increase the pounds of lamb weaned by 15 to 20 percent, gross receipts for the New Mexico sheep industry would increase by $1 million.
Managing Change in Agricultural Systems

Experiment Station scientists are investigating different grazing regimes to maintain New Mexico agriculture in areas where water resources are decreasing. Scientists are continuing studies at the Alcalde and Tucumcari agricultural science centers that compare stand establishment and pasture composition using selected perennial forage legumes and various grazing regimes.
Risk Management

Farmers lose money when the price of grains and livestock goes down; utilities lose when the cost of fuel cannot be passed on to customers; banks lose when interest rates change; and energy producers lose when the price of natural gas or petroleum goes down. There are methods available to control the risks. Experiment Station researchers are working to identify the major sources of price risks and the proper tools to manage those risks. If 1 percent of the businesses that have gone bankrupt in New Mexico could have avoided it by using price risk management tools, the value to the state would be approximately $10 million.

Small Farm Viability

Experiment Station researchers found that small-scale farmers in northern New Mexico can greatly increase productivity by using alternative crops and cropping methods. By adapting and fine-tuning the tested alternative crops and methods on their farms, many producers in the region could increase farm profits as well.
Integrated Pest Management

The term Integrated Pest Management (IPM) was coined about 30 years ago to describe a concept in agricultural production involving the evaluation and incorporation of all available techniques (old and new, low tech and high tech) into a unified program to identify and manage pest populations so that economic damage to crops is avoided and adverse effects on the environment are minimized.

Protecting Cotton

Experiment Station scientists are developing management tools to protect cotton fields from boll weevil, bollworm and beet armyworm in our semiarid climate. Researchers are testing new formulations of the pesticide malathion that could cut applications in half, saving U.S. cotton farmers more than $30 million per year on boll weevil control. Researchers also are working to develop pest management techniques that can suppress insect populations without insecticides, which can decrease farmers’ costs and the environmental impact.

Improving Animal Health

Researchers have conducted a survey to evaluate the extent of the housefly problem facing dairy producers. One of the goals of the housefly research is to reduce large-volume insecticide use by implementing the most effective insecticides and delivery systems; determining the most effective time, place and method to apply insecticides; and integrating non-insecticidal pest management methods into control programs.

Using Beneficial Insects

Pecan nut casebearers are insect pests of pecan trees that cause economic losses. Experiment Station researchers are studying how beneficial insects affect pecan nut casebearer mortality. Understanding the life cycles of beneficial insects is crucial for controlling pecan nut casebearers and reducing pesticide use.
Remote Sensing Technology for Crop and Pest Management

Remotely sensed data using infrared photography and satellite image data offer an inexpensive way to obtain information on crop and environmental conditions. Experiment Station scientists are developing remotely sensed data and computer-based management systems to help farmers offset rising production costs by reducing chemical and cultivation costs.

Agricultural Waste Management

Dairy wastes have the potential to contaminate water tables with nitrates, which could create human health risks. Experiment Station scientists have found that using compost instead of raw manure as a nutrient source can lower the environmental impacts to agricultural land. Long-season cropping and composting systems also can help reduce residual soil nitrate levels.

Biodiversity and Landscape Fragmentation

Experiment Station scientists are studying the effects of habitat and landscape fragmentation due to land use and development on plant and animal diversity. Further refinements to estimating diversity loss due to habitat use can help natural resource managers develop appropriate conservation efforts.

Biological Control of Toxic Plants

Experiment Station scientists have found that certain insects prefer to eat varieties of woolly locoweed, silky crotalaria, Lambert’s crotalaria, and broom snakeweed—plants that cause livestock health problems resulting in large economic losses. The researchers now are evaluating the genetic relationships among the New Mexico weed varieties. By understanding weed genetic variability, it is possible that new, alternative strategies will be developed for managing and sustaining agroecosystems.

Forest Resource Management

There are nearly 15.2 million acres of forests in New Mexico. Experiment Station researchers are developing growing techniques for native woody plants for use as forestation plantings in this region. Native woody plants are adapted for the region’s climate and require less management to grow. The results could affect reforestation, restoration, reclamation and revegetation efforts in the state by reducing production costs and improving the quality of planting stock.
Wildlife Management

Western rangeland deterioration is a serious environmental problem facing the ranching industry. By using wild ungulates in conjunction with livestock, ranchers can make more efficient use of native vegetation without degrading rangelands, resulting in greater profitability. Experiment Station scientists are investigating the effects of vegetation types and season on oryx (an imported game species) distribution, habitat use and preference in areas occupied by native mule deer and pronghorn antelope. This project will determine the availability of plant species in areas where oryx, mule deer and pronghorn home ranges overlap.

Invasive Weeds

Yellow starthistle is spreading steadily on Western rangelands, reducing the carrying capacity on grazing lands as well as causing serious damage to other lands, including recreational areas. Currently, this noxious weed can be controlled at the seedling stage by the herbicide picoaram. Experiment Station scientists are working to determine the inheritance of picoaram resistance by yellow starthistle. By understanding the inheritance of herbicide resistance, weed management can be modified to avoid developing herbicide resistance in yellow starthistle.

Pesticide Application

If pesticides drift in the wind after being sprayed, they can endanger people, harm beneficial insects and plants, and cost farmers money. Experiment Station scientists investigated how to reduce pesticide drift for pecan orchards using low total spray volumes atomized into very fine spray droplets. The application of lower spray volumes allows an aircraft to treat more acres per hour during favorable weather conditions with little risk of pesticide drift that can endanger neighboring residents.
Research Highlights

Quality of Life for New Mexicans

Food Handling

Independent restaurants in rural New Mexico are threatened by chain competition and changing demographics. Experiment Station scientists have formulated a matrix of critical factors that contribute to the success of these restaurants, including the facility’s uniqueness, management, marketing efforts, sanitation/cleanliness, staff training, and use of New Mexico’s agricultural products. Experiment Station scientists also are identifying the best practices of successful restaurants in rural New Mexico to provide guidance to current owners and those considering opening a new operation.

Food Quality

Experiment Station researchers have analyzed the fiber content of dried red chile pods and dried, ground red chile. Red chilies are a good source of dietary fiber, as well as vitamins A and C. Information from this analysis will be useful for labeling and generating food composition tables, which currently contain little or outdated information on chile products.

Food Safety

Listeria monocytogenes, which can cause a potentially fatal food poisoning, is a major concern of the food industry, especially the dairy and ready-to-eat processed meat industry, because the pathogenic bacterium thrives at cold temperatures.
Experiment Station scientists have investigated the ability of *L. monocytogenes* to survive in soil and water; in animal feed and feces; on animal skin, floors, walls and equipment in a slaughter floor environment; and with competing bacteria. The researchers have shown that *L. monocytogenes* 4b can live in a wide temperature range for at least 42 days. Specific information on the survival and recovery of this pathogenic bacterium from the environment will help food processors prevent or decrease its occurrence in animal-based food products.

**Human Nutrition**

Good nutrition throughout the life span can help reduce the incidence of osteoporosis in the elderly. Experiment Station scientists are involved in a multistate human nutrition research effort to determine the effect of various food components and environmental activities (for example, smoking and exercise) on the bioavailability of vitamins and minerals. In New Mexico, research focuses on how fat and fiber in the diet of New Mexican teenagers affects the intake and absorption of calcium, which is critical to decreasing the risk of osteoporosis. Research results will be used to tailor nutrition education programs for this segment of the population.

**Jobs/Employment**

Communities and businesses are struggling to adapt to changes in the workforce. When stressors on the job occur, professionals “bring their troubles home.” Experiment Station scientists are investigating how individuals regard their multiple roles to determine how issues of identity and sense of self affect the well-being of individuals and families, as they respond to social and economic changes.

**Parenting**

Experiment Station scientists have examined parenting in single-parent families, comparing single mothers with single fathers and divorced parents with never-married parents. The researchers have found that single fathers successfully manage the parenting role as well as single women. A follow-up study will look at economic strain in single-parent households. This project will create parenting programs designed to meet the special needs of single parents.

**Tourism**

Experiment Station researchers are investigating the current state of agricultural tourism in New Mexico. Agra-tourism represents a potentially important form of sustainable tourism development for rural communities. Not only does it provide agricultural communities with the opportunity to profit financially, but it also provides an opportunity to educate others about the nature and complexity of farming and ranching today.
New Mexico State University's Agricultural Experiment Station Administration
Jerry G. Schickedanz
Dean and Chief Administrative Officer
College of Agriculture and Home Economics

I. Miley Gonzalez
Associate Dean and Director
Agricultural Experiment Station

LeRoy A. Daugherty
Associate Director
Agricultural Experiment Station

Departments
New Mexico State University
Las Cruces, NM 88003

Agricultural Economics and Agricultural Business
Lowell Catlett, Interim Head

Agricultural and Extension Education
Thomas Dormody, Head

Agronomy and Horticulture
James Fisher, Head

Animal and Range Sciences
Mark Wise, Head

Entomology, Plant Pathology and Weed Science
H. Grant Kinzer, Head

Family and Consumer Sciences
Ann Vall, Head

Fishery and Wildlife Sciences
Donald Caccamise, Head

Hotel, Restaurant and Tourism Management
Michael Cerletti, Head

Agricultural Science Centers
Sustainable Agriculture Science Center at Alcalde
Steven Guldan, Superintendent

Agricultural Science Center at Artesia
Martina Murray, Superintendent

Clayton Livestock Research Center
Superintendent position vacant

Chihuahuan Desert Rangeland Research Center
Reldon Beck, Coordinator

Agricultural Science Center at Clovis
R. Darrell Baker, Superintendent

Corona Range and Livestock Research Center
Eugene Parker, Superintendent

Fabian Garcia Research Center
James Fowler, Superintendent

Agricultural Science Center at Farmington
Michael O’Neill, Superintendent

Leyendecker Plant Science Research Center
James Fowler, Superintendent

Agricultural Science Center at Los Lunas
L. Michael English, Superintendent

Mora Research Center
John Harrington, Superintendent

Agricultural Science Center at Tucumcari
Rex Kirksey, Superintendent
Income Distribution
Fiscal Year 2000/2001
(Total = $19,630,952)

Grants and Contracts 28%
Federal Appropriations 9%
State Appropriations 55%
Other 7%

Expenditure Distribution
Operations 28%
Personnel 72%