

AGENCY OVERVIEW

Main Research Station

North Dakota Agricultural Experiment Station

Agency Statutory Authority

North Dakota Constitution, Article XIX; North Dakota Century Code Chapter 4-05.1

Agency Description

The North Dakota State University Main Research Station is on the campus of the North Dakota State University of Agriculture and Applied Science. The station is the administrative location of the Agricultural Experiment Station. The station conducts research and coordinates all research activities of the Agricultural Experiment Station. The research has, as a purpose, the development and dissemination of technology important to the production and utilization of food, feed, fiber and fuel from crop and livestock enterprises. The research provides for an enhancement of economic development, quality of life, sustainability of production and protection of the environment. The Main Research Station keeps detailed records of all activities and publishes the information that will be of value to the residents of this state.

Agency Mission Statement

The Agricultural Experiment Station shall develop and disseminate technology important to the production and utilization of food, feed, fiber and fuel from crop and livestock enterprises. The research must provide for an enhancement of the quality of life, sustainability of production and protection of the environment.

Agency Performance Measures

Per NDCC 4-05.1-19, the State Board of Agricultural Research and Extension (SBARE) presents a status report to the budget section of the Legislative Council. SBARE's most recent presentation to the budget section was on June 14, 2006. The report it gave and provided in written form included the status of the North Dakota Agricultural Experiment Station and the NDSU Extension Service. A copy of the information is on file in the Legislative Council office.

Agency Future Critical Issues

The NDAES continues to face challenges in sustaining an infrastructure in which to do high quality research. Shortfalls occur in quality greenhouse and plant research facilities, especially those for transgenic plants that will be introduced more frequently. Studies on transgenic crops will increase as methods to incorporate disease, insect and environmental stress resistance are more available. Our scientists travel farther each year in the state to conduct site-specific research. Major problems occur in acquisition of costly field and laboratory equipment that cannot be obtained through grants. The NDAES has insufficient laboratory space to meet the needs of 21st century agriculture. North

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NDSU
North Dakota State University
**ND Agricultural
Experiment Station**

AGENCY OVERVIEW: Main Research Station

Dakota is becoming increasingly urban, and urban populations require products and services that are different than those needed by livestock and crop producers. Continual efforts to improve horticultural research are occurring, and the NDAES is addressing the needs by expanding campus research and demonstration plots. However, efforts need to continue to allow the NDAES to serve this segment of agriculture. Increased focus on food safety and natural resource management provides opportunities for growth and response to pressing national needs. Our research programs will attract doctoral students who will significantly enhance research efforts. Continued improvements in nutrition and feeding facilities for livestock research are needed. This is particularly needed when quality control feedlot trials and consistent product evaluation are required for scientific evaluations. The Center of Excellence for Beef Systems will fill a void in the research and education mission of our animal scientists. This center also will provide much-needed information to beef cattle producers on how to improve herds for desired meat quality traits. Our strength is in our researchers, but they are too few to cover all of the critical issues facing North Dakota agriculture, and the lack of adequate numbers precludes important faculty development. Through the years, faculty positions have been lost, and lost positions cannot be redirected. For some units, additional technical support would significantly increase productivity of researchers. Faculty are responsible for attracting external funding, and their success during this biennium is impressive; however, the commensurate effort to write more — and larger — grants is apparent, and we have concerns about additional pressures that fundraising has on faculty effectiveness. Rural populations continue to decline, and the dynamics of the farming population are changing. Communication to help sustain farmers/communities is critical, and the need to translate research information into useful formats is apparent. In addition to building the technologies for communication, we need to promote the development of high quality information that is transmitted by the technologies.

Impacts of Reinvesting in Critical Areas

The executive recommendation for the NDAES included a general fund increase of \$3,707,258 above the 2003-05 appropriation. This enhancement was addressed as follows:

1. Funds for 2.2 percent annual operating inflation
2. Two full-time equivalents (FTEs) for the Beef Systems Center of Excellence
3. An ethanol and malting barley initiative at the Dickinson Research Extension Center (REC) to be funded with Dickinson oil revenues
4. The executive recommendation included funding authority for:
 - a. Research greenhouse complex for the Main Research Station
 - b. Agronomy lab and greenhouse at the North Central REC

Implementation of legislative changes to the executive proposed budget, 2005-07

The North Dakota Agricultural Experiment Station was the recipient of a number of items in the 59th Legislative Assembly. Based on differences between Senate and House amendments to SB2020, conference committee changes and the resulting implementation, they are listed below:

- **Added general fund support for the Western Malting Barley project at various research centers: Main Station (\$99,050), Dickinson (\$3,046), Hettinger (\$8,000) and Williston (\$118,105).**

These funds were distributed to the appropriate RECs as directed. Main Station scientists received funding for this project as in the past — continuing research agendas were funded, no new projects proposed under the guidelines of the Western Malting Barley Project.

- **Added \$148,103 for the Beef Systems Center of Excellence (to the governor's recommendation of \$301,897) for a total of \$450,000 for salaries of two authorized FTE positions and other operating costs of the center.**

Since this partnership came into existence, the criterion identified by the Legislature was met; therefore, two positions in the Animal and Range Sciences Department were created, advertised and recently filled for this research program.

- **Added \$325,165 for extraordinary repairs, with \$100,000 to be used to construct a machine storage shed at the Williston REC.**

\$100,000 was provided to the WREC for construction of a machine storage shed — a bid for construction of this shed was accepted and construction was completed in fall 2006. Extraordinary repair funds were distributed to the Main Station and all RECs based on a prioritized list of needed repairs (collated and maintained by the Main Station).

- **Added \$150,000 for salary of one authorized FTE position in dry bean breeding/genetics.**

A position description was developed and the position advertised. Two candidates were found acceptable, but both turned down the position. The position was readvertised and filled in October 2006.

- **Added \$200,000 for operating and equipment needs for the Main Station, branch stations and Extension Service, with allocation to be determined by the State Board of Agricultural Research and Education (SBARE).**

A proposal to allocate funding and equipment needs to the Main Station, the RECs and Extension Service was presented to SBARE for approval in July 2005. The proposal called for \$50,000 to the Main Station to establish a revolving fund among departments for equipment purchases, similar to the revolving fund used for the RECs; \$84,000 to the RECs (each REC allocated \$12,000 to help offset rising costs of fuel,

Impacts of Reinvesting in Critical Areas

ITD and other costs); and \$66,000 to the Extension Service. The proposal was accepted by SBARE.

- **The Legislature allowed a carry-over of \$800,000 to the Main Station to develop a Center of Excellence-Beef Systems, with the condition that an additional \$2.2 million can be raised from federal and private sources.**

The Beef Systems Center of Excellence is under way. The following have been accomplished:

- A private company, North Dakota Natural Beef LLC (NDNB), was created and has been capitalized through more than \$4.1 million in equity financing. The company will harvest cattle at the North American Bison Cooperative facility at New Rockford. Carcass pieces will be transported to Fargo for fabrication, value-added processing, packaging and marketing.
- NDNB is finalizing plans to refurbish the Fargo facilities near the NDSU campus that will be the site for the processing. Within these new facilities will be about 6,000 square feet of space devoted to the Beef Systems Center research and education activities of NDSU. NDSU's commitment is to work not only with North Dakota Natural Beef, but also with any other current or prospective processors.
- The State Board of Agricultural Research and Education (SBARE) concurred in spring 2006 that NDNB is an appropriate partner for NDSU in the Center of Excellence. This resulted in the release of funding for the two faculty positions authorized during the 2005 legislative session.

- **Provided \$2,000,000 in bonding authority and authority to raise \$5,000,000 in other funds for a research greenhouse complex at the Main Station.**

A fundraising committee was formed and is in the process of identifying and contacting possible donors to raise the \$5,000,000 for Phase I of this multiphase construction project.

- **Provided \$440,000 in bonding authority and authorized \$1.25 million in other funds to construct an agronomy lab and greenhouse at the North Central REC.**

The NCREC, through a fundraising effort, raised more than \$1.25 million in other funds to facilitate construction of this facility. Groundbreaking occurred in July 2006 and the project is well under way.

- **Provided \$270,000 in bonding authority and authorized \$80,000 in other funds to construct an addition to the headquarters building at the Central Grasslands REC.**

The CGREC, through a fundraising effort, obtained \$80,000 for this project. The groundbreaking occurred in September 2006 and the project should be completed before March 2007.

Construction of Greenhouse Complex

NDSU Agriculture and University Extension
North Dakota Agricultural Experiment Station

FACILITIES

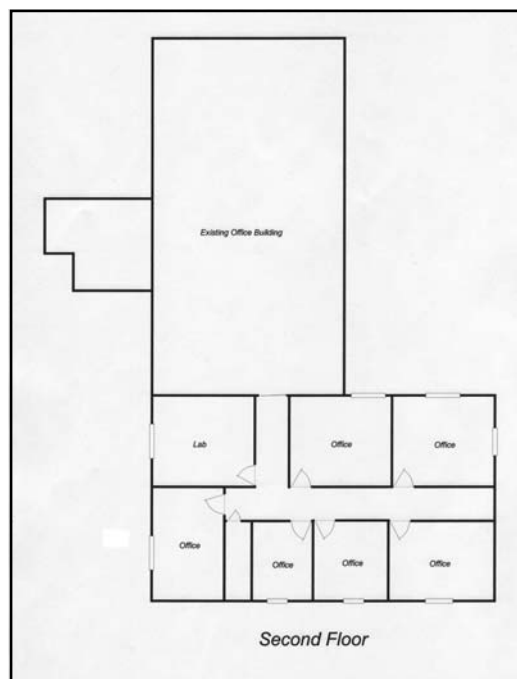
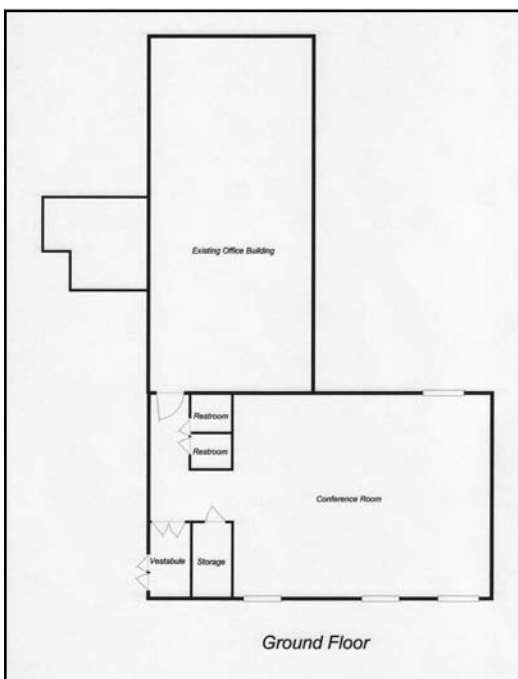
Central Grasslands Research Extension Center Office Addition

The addition to the Central Grasslands Research Extension Center (CGREC) office building was included as priority No. 2 by the State Board of Agricultural Research and Education. This addition is 30 feet by 50 feet on two floors for a total of 3,000 square feet. This project was funded by the 2005 Legislature at \$350,000, with \$270,000 bonded and the rest raised locally.

This addition will contain a conference room on the main floor, which will be equipped with high-speed Internet and videoconferencing equipment. The second floor will include six offices and a laboratory. This addition will allow for all the staff at the CGREC to have individual offices. In addition, it will allow cooperating scientists working at the CGREC to have an office equipped with computers and high-speed Internet service. The bids were let for construction in June and construction began in late July. On Jan. 1, 2007, the building was enclosed and the interior work was progressing nicely. A completion date of late February is expected.

Construction Costs

General contractor	\$207,000
Mechanical	\$46,875
Electrical	\$33,325
Fire escape stairs	\$4,800
Architect	\$27,000
Miscellaneous	\$15,000
Furnishings	\$16,000
Total	\$350,000



Construction of Laboratory and Greenhouse

NDSU Agriculture and University Extension
North Dakota Agricultural Experiment Station

FACILITIES

North Central Research Extension Center **Agronomy Laboratory and Greenhouse**

Jan. 18, 2007 Sections 902.3 & 902.5

Requested Action:

NDSU requests authorization to carry over \$1,690,000 (or any remaining unused balance) of the total authorization approved in 2005-2007 for the agronomy research laboratory and greenhouse at the North Central Research Extension Center.

Background Information:

On April 14, 2004, NDSU requested and was granted authorization by the SBHE to proceed with fundraising efforts for a new agronomy research laboratory and greenhouse at the North Central Research Extension Center. NDSU subsequently sought and received authorization at the Jan. 27, 2005, SBHE meeting to amend its 2005-07 budget request to increase the cost of the project to \$1,690,000 and to change the source of funding for the project from \$750,000 in gifts, grants and contracts to \$1,250,000, along with \$440,000 from state bonding. The project was included and was authorized by the Legislature in SB 2023. The 2007-2009 executive budget included an additional \$400,000 for the completion of the remaining alternates in the architect's plan.

The SBHE authorized NDSU to proceed with the project at its May 17, 2005, meeting. Construction began in August 2006, and as of today, the shell of the project has been completed. The final project completion date is expected to be July 2007.

The 2007-2009 executive budget included an additional \$400,000 for the completion of the remaining alternates in the architect's plan.

Project Description:

The new research lab will create a more efficient flow of materials from seed preparation through harvesting, seed cleaning and sample analysis. A greenhouse, spray chamber and growth chamber will fill a critical void in the NCREC's research capabilities, completing its field research with the ability to conduct studies under controlled conditions. The lab will provide a safer and cleaner working environment, as well as a climate-controlled area for germplasm archives. It also will provide a work environment that:

- Ensures more accurate and detailed production information that can be used to optimize yields
- Enables the discovery and development of new cropping practices and pest management methods, which helps ensure that producers have the latest technology to combat pests and optimize soil fertility
- Is more suitable for oil and protein analysis using the NIR/NMR; since 1999, this equipment has saved NDSU nearly \$250,000, compared with commercial analysis
- Eliminates elevators and stairs by locating all rooms on one floor
- Provides temperature-controlled areas to eliminate data inconsistencies that occur from temperature fluctuations
- Increases available working areas for crop production research, including pest diagnostics, seed treating, counting, weighing, packaging, drying, washing, dissecting, rating, etc.
- Enhances education and outreach programs

The addition of a greenhouse to the new research lab also is desired. Local and NDSU Main Station (Fargo) greenhouse research options are restricted due to limited greenhouse space, as well as logistical and time constraints. A new greenhouse will create opportunities to conduct preliminary crop evaluation and weed, disease and insect studies prior to the growing season. Controlled conditions will provide opportunities to study the influence of soil pH, fertility, relative humidity, temperature, etc., on crop and pest management. This, along with the enhanced educational activities that a greenhouse would provide, makes it a necessary component of the project.

Construction of Greenhouse Complex

NDSU Agriculture and University Extension
North Dakota Agricultural Experiment Station

FACILITIES

Main Station - North Dakota Agricultural Experiment Station Research Greenhouse Complex - Phase I

Jan. 18, 2007 Sections 902.3 & 902.5

Requested Action:

NDSU requests carryover authorization for Phase I of the Main Station Research Center Greenhouse Complex approved in the 2005-2007 biennium in the amount of \$7,000,000.

Background Information:

Phase I of the Main Station Research Center Greenhouse Complex appeared as priority No. 1 in the 2004 NDSU Campus Master Plan for the NDAES. The project was authorized in SB 2023:

"The main research center may obtain and utilize federal funds and other funds to assist in the construction of a greenhouse complex at the main research center. There is appropriated to the main research center the sum of \$5,000,000, or so much of the sum as may be necessary, from any federal acts, private grants, gifts and donations, or other funds that may become available for this project for the biennium beginning the effective date of this Act and ending June 30, 2007."

Project Description:

The North Dakota Agricultural Experiment Station (NDAES) needs secure greenhouse space to conduct research on transgenic crops to meet consumer demands and to respond to the threat of bioterrorism. This project will involve new construction and will implement the renovation of selected existing greenhouses to address the critical need for state-of-the-art greenhouse space for NDAES researchers. The project has a high priority ranking because of the current condition of the existing greenhouses and the requirements for expanding AES research needs.

Each greenhouse compartment within a range shall have de-ionized and regular water systems, a fertilizer injection system, heating, lighting, ventilation and environmental controls. Independent room access is required for security purposes and to minimize contamination of rooms by workers and transported plant material. Approximately 24 compartments, each 800 square feet in size, are needed to meet current and expected future demands for high quality research space.

The headhouse area will include eight laboratories, controlled-environment seed storage rooms, a large threshing/storage room, propagating material room, freezer room, three drying rooms (with 15 dryer units) and two large growth chamber areas sufficient for 24 chambers each. The structure shall include restrooms and changing/locker rooms. It will be planned with future expansion in mind to conform to the future needs of NDAES research priorities and goals.

The location of this facility shall be in proximity to other on-campus laboratory research facilities because of the need to transport plant material between buildings in the winter, for access by student labor and for the convenience of graduate students and faculty.

Funding:

The project will be funded from \$2,000,000 in state bonding and \$5,000,000 in special funds. Carryover of this authorization will allow NDSU to continue to raise funds to meet the \$5,000,000 goal in special funding. Construction of Phase I is expected to start in the 2007-2009 biennium.

The 2007-2009 NDAES executive budget included an additional \$9,000,000 for the completion of Phase II of the three-phase greenhouse project. Phase II will consist of the construction of the remaining non-transgenic greenhouses, equipment and fitting out several rooms that are "shell only" in Phase I.

Main Research Station

Research Greenhouse Complex - Phase I

Total Facility\$30,000,000
 (Includes: Headhouse and 3 pair Greenhouses and Biosafety Level 2 Headhouse and 4 pair Greenhouses)

Phase One*\$ 7,000,000

Phase Two\$ 9,000,000

Remaining Phases\$14,000,000

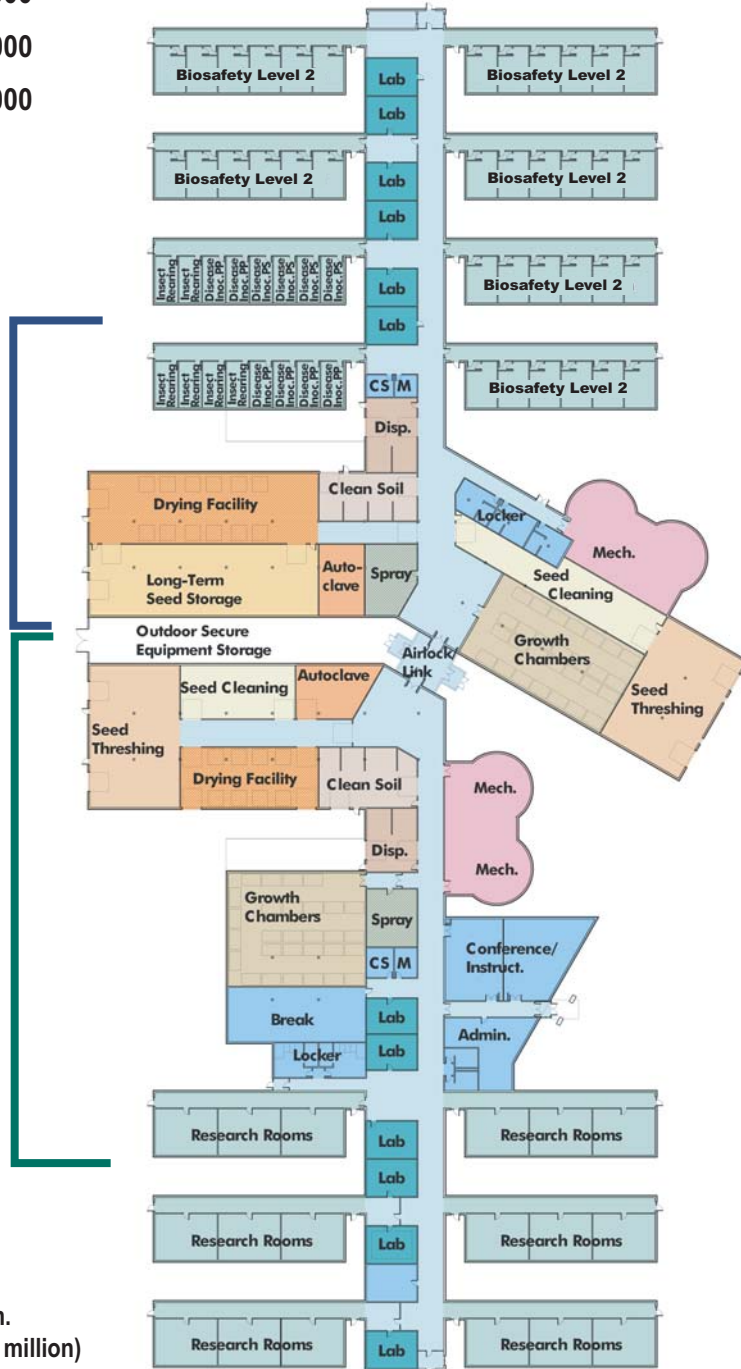
Notes:

Prices include provision for heating, air conditioning and essential services to service total facility.
 Total price include minimal provision for equipment \$375,000 and furniture and fittings \$50,000.
 Pricing as at 18 July 2006. Includes inflation provision of 8% (Commence Summer 2008). Prices rounded to nearest \$10.

Phase Two
 Biosafety Level 2 Headhouse
 and 1 pair of Greenhouses

Phase One
 Headhouse and
 1 pair of Greenhouses

- | | |
|---|--|
| ■ A. RESEARCH ROOMS | ■ H. CLEAN SOIL STORAGE |
| ■ B. RESEARCH LABS | ■ I. SOIL DISPOSAL |
| ■ C. GROWTH CHAMBERS | ■ J. SPRAY ROOM |
| ■ D. SEED THRESHING | ■ K. CONF./ADMIN./STORAGE |
| ■ E. SEED CLEANING | ■ L. CIRCULATION/STORAGE |
| ■ F. DRYING FACILITY | ■ M. MECHANICAL |
| ■ G. AUTOCLAVE | ■ PHASE 2 AREAS |



* Phase I - \$7,000,000 authorized in 2005-2007 Biennium.
 State Bonding Funds (\$2.0 million): Other Funds (\$5.0 million)

Main Research Station

2007-09 Needs-Based Budget

An increase of \$8,295,600 or 15 percent above the 2005-07 general fund base would provide funds to address priorities of the State Board of Agricultural Research and Education and related needs of North Dakota agriculture. The Main Research Station is including \$2,777,100 (of the \$8,295,600) in its optional package.

SBARE ranked all of the projects for Extension, Main Station and branch stations together since a lot of the projects are joint efforts. Please refer to the ranked projects by reviewing the narrative in all of the agencies.

SBARE Ranking **NDSU Main Research Center - \$2,777,100 (Branch Stations \$2,282,700)**

No. 1 ranked: AES Equipment and Operating Pool

\$940,000 Total General Fund Increase

(\$490,000 equipment and \$450,000 operating)

Main Station \$355,000 equipment

Hettinger \$11,666 equipment

Streeter \$11,667 equipment

Langdon \$11,667 equipment

North Central \$100,000 equipment

Main Station \$200,100 operating

Dickinson \$35,700 operating

Central Grasslands \$35,700 operating

Hettinger \$35,700 operating

Langdon \$35,700 operating

North Central \$35,700 operating

Williston \$35,700 operating

Carrington \$35,700 operating

Equipment Pool – A revolving fund for equipment purchases has been extremely successful for the Research Extension Centers to maintain their equipment base. Establishment of this fund has allowed each REC to purchase expensive research equipment on a timely basis, with a degree of regularity. In the 2005-07 legislative session, a small amount of funding (\$50,000 to the Main Station for equipment) was used to establish a similar revolving fund for the research departments on the Main Station. To effectively purchase both field and laboratory equipment, which is extremely difficult using competitive grant funds, additional funding to the base of each of these revolving funds is needed for the Main Station and RECs to utilize the funds successfully.

Operating funds – A formula of \$6,100 per scientist year (SY) has been used for allocating operating funds to departments on the Main Station. The costs associated with conducting research important to the state continue to increase. An increase in the formula funding to \$10,000 per SY is needed to stay in line with inflation and should be sufficient for several years. In addition, increased operating funds for the RECs are needed to offset increases in fixed operating costs, including energy.

NDSU Main Research Station

North Dakota Agricultural Experiment Station

No. 2 ranked: Bioproducts/Bioenergy Development**\$400,000 Total General Fund Increase**

(\$120,000 salary and fringe benefits, .6 new FTE) – engineering faculty Main Station

(\$100,000 salary and fringe benefits, 1.0 new FTE) – research specialist Main Station

(\$80,000 salary and fringe benefits, .4 new FTE) – economics faculty Main Station

(\$100,000 Main Station operating funds)

Engineering faculty position (60 percent research, 40 percent Extension)

Focus on biomass-based systems, which hold great potential for becoming the preferred sources for liquid fuels. Needed research will focus on harvest, collection and transport systems for raw products, including crops, crop residues, animal production coproducts, byproducts from food processing, etc. Additional work will focus on conversion systems (engines, gasifiers, etc.) that will improve efficiency of conversion of cellulosic and other materials to liquid fuel and other products.

Research specialist to assist faculty position.

Economics faculty position (40 percent research, 60 percent Extension)

Focus on determining production costs, logistics and market analysis for biobased products. Working closely with colleagues throughout the university system, research would lead to the development of efficient processes for supply chain management and for efficient processing strategies.

No. 2 ranked: REC Support Staff**\$462,800 Total General Fund Increase**

(\$462,800 Salary and Fringe benefits, 7.0 new FTE - (1 FTE at each branch station)

Support Staff (7) – Research Extension Centers have a desperate need for additional office support staff to deal with the changing and increasing demands of today's workplace. Decentralization and an increase in recordkeeping for compliance issues, regulation, scheduling, accountability, data management and other facets of the ever-changing technologies place extreme pressure on a reduced work force to remain current.

No. 3 ranked: Scab (operating, NDAWN, etc.)**\$625,000 Total General Fund Increase**

(\$425,000 operating scab)

Main Station operating \$350,000

Langdon operating \$25,000

Carrington operating \$25,000

North Central operating \$25,000

(\$200,000 operating NDAWN)

Main Station operating \$200,000

Operating for breeding/genetics, plant pathology, cereal quality and entomology research programs to enhance efforts on scab resistance, pest management and improved quality. Enhanced support of these programs is essential to maintain an advantage over the pest's ability to change and cause major economic losses to the state's farmers, as evidenced by the disastrous outbreaks of scab the last several years.

NDAWN support and field scouting – One research specialist will work on the NDAWN weather network to aid in the development of predictive models for disease development and to distribute timely weather information needed by producers to determine timing of pesticide application. Crop scouts located throughout the state will aid in identifying development of scab in various production regions in the state. Disease development will be monitored and compared to predictive crop models – these highly successful forecasting models continue to be improved as additional information is added to the model.

NDSU Main Research Station

North Dakota Agricultural Experiment Station

No. 3 ranked: Pulse Improvement**\$470,000 Total General Fund Increase**

(\$200,000 salary and fringe benefits, 1.0 new FTE faculty) - Main Station

(\$150,000 salary and fringe benefits, 1.0 new FTE assistant breeder) - NCREC

(\$120,000 operating funds for pulse program)

Main Station operating \$80,000

North Central operating \$40,000

Pulse improvement program – North Dakota has experienced rapid growth and continued interest in the pulse industry. Acreages of peas, lentils and chickpeas have increased dramatically, particularly in the central and western regions of North Dakota. North Dakota leads the nation in pea production and acreage will continue to increase as demand continues. Pea production provides many benefits to the soil and environment and is an excellent protein source for livestock feed. A faculty position at the Main Station is needed to develop improved varieties of peas, lentils and chickpeas that are adapted to the northern Great Plains. An assistant breeder/agronomist to be located at the NCREC will aid the effort to develop improved varieties and evaluate appropriate production techniques.

No. 4 ranked: Waste Management**\$280,000 Total General Fund Increase**

(\$160,000 salary and fringe benefits, .8 new FTE) Main Station

(\$84,000 salary and fringe benefits, .6 new FTE) Carrington

(\$36,000 operating funds)

Main Station \$24,000 operating

Carrington \$12,000 operating

Engineering (80 percent research, 20 percent Extension). A faculty member in Ag and Biosystems Engineering will focus on development of innovative waste management systems with an emphasis on developing uses and products from wastes that can generate revenue for the enterprise, minimize odors and reduce costs for production.

Waste management specialist (60 percent research, 40 percent Extension) located at Carrington. To work with animal production, feedlot, engineering colleagues and livestock producers in developing economical and efficient systems.

No. 5 ranked: Host Resistance and Pest Research**\$700,000 Total General Fund Increase**

(\$700,000 salary and fringe benefits, 7.0 new research specialists FTE @ \$100,000 each)

2 FTE Main Station, 2 FTE Williston, 1 FTE Carrington, 1 FTE North Central, 1 FTE Langdon

Host resistance and pest biology – research specialists (7) will enhance ongoing efforts to more rapidly develop varieties with improved resistance to major diseases, including sclerotinia, wheat and barley scab, blackleg, root rot and other diseases affecting major crops in the state and to understand the biology of the pathogens important to the cropping systems in the state. Two specialists will be located at Fargo (Main Station), two at Williston REC (one to focus on barley improvement with supervision from Main Station scientists) and one each at the CREC, NCREC and LREC.

No. 6 ranked: Swine Specialist**\$100,000 Total General Fund Increase**

(\$80,000 salary and fringe benefits, .4 new FTE) - Main Station

(\$20,000 operating) - Main Station

Swine specialist – At one point in time, North Dakota produced more than 500,000 market hogs per year and had more than 2,000 producers. Presently North Dakota produces 160,000 market hogs and has 450 producers. However, because of its economic impact, interest in increasing swine production in the state has grown recently. Each dollar of return from pigs marketed turns over 3.49 times for feed, labor, trucking, vet service, utilities, etc. This industry needs technical expertise, management assistance and an unbiased resource that can help the state develop its hog industry. A swine specialist that is 60 percent Extension, 40 percent research is needed to fill this role.

NDSU Main Research Station

North Dakota Agricultural Experiment Station

No. 7 ranked: Livestock Development**\$58,000 Total General Fund Increase**

(\$40,000 salary and fringe benefits, .2 new FTE) - Main Station

(\$18,000 operating) - Main Station

Livestock industry specialist (80 percent Extension, 20 percent research). There are many driving forces, including the desire of many ag producers to grow their existing enterprises and/or to diversify their operations, utilization of potential feedstuffs that are shipped to other states for their livestock operations, opportunities to enhance production of feedstuffs to service a growing North Dakota industry, use of coproducts emerging from the rapidly expanding bioenergy/bioproductions enterprises as feedstuffs and utilization of grazing capacity in range and managed areas. A faculty position will work continually with colleagues and industry to evaluate opportunities and to provide information that can be used for timely decision making.

No. 7 ranked: Pest Management**\$128,000 Total General Fund Increase**

(\$128,000 salary and fringe benefits, .8 new FTE) - Carrington

Area pest management specialist – This 80 percent research, 20 percent Extension position is critically needed to provide information to area growers affected by crop diseases. The position will be located at the Carrington REC. The CREC is in the center of great crop diversity, an area that has been greatly affected by severe outbreaks of many major diseases.

No. 8 ranked: Pest Application Research**\$90,000 Total General Fund Increase**

(\$90,000 salary and fringe benefits, 1.0 new FTE, research specialist) - Main Station

Improving pesticide application efficiency – One research specialist is needed to continue efforts to identify the best methods to apply pesticides effectively and efficiently to control scab.

No. 9 ranked: Livestock/Range**\$322,000 Total General Fund Increase**

(\$294,000 salary and fringe benefits, .7 for each of the 3 new FTE @ \$98,000 each)

3 FTE - 1 FTE Streeter, 1 FTE Hettinger, 1 FTE Main Station

(\$28,000 operating)

Main Station \$12,000

Central Grasslands \$8,000

Hettinger \$8,000

Three livestock/range specialists (70 percent research, 30 percent Extension) to compare whole-systems management of organic, natural, grass-fed and conventional beef production systems, as well as the relationship of these systems to the environment. Help determine market causes affecting cattle sales. Feedlot research will focus on evaluating coproduct use for efficient livestock production. One specialist will focus on animal health issues. The specialists will be located at the Central Grasslands REC near Streeter, Hettinger REC and the Main Station.

No. 10 ranked: Irrigation**\$180,000 Total General Fund Increase**

(\$180,000 salary and fringe benefits, 1.0 new FTE, research scientist) - Williston

Irrigated agriculture is becoming increasingly important in northwestern North Dakota, with high-value crops evident in the region. One research scientist is needed to evaluate irrigated production practices in North Dakota, to be stationed at the WREC.

NDSU Main Research Station

North Dakota Agricultural Experiment Station

No. 11 ranked: Food Industry

\$250,000 Total General Fund Increase

(\$120,000 salary and fringe benefits, .6 new FTE faculty) - Main Station

(\$100,000 salary and fringe benefits, 1.0 new FTE faculty) - Main Station

(\$30,000 operating funds) - Main Station

Faculty position (60 percent research, 40 percent Extension)

Position in enhanced processing of existing and new crops. Will have expertise in processing/engineering/plant operations. Will work in collaboration with colleagues throughout system to assure that supply chains, as well as processing, are optimized. Will work in close collaboration with business/marketing and technical associates in agricultural business development program above.

Research specialist to assist faculty position.

No. 12 ranked: Sustainable Agriculture

\$54,000 Total General Fund Increase

(\$54,000 salary and fringe benefits, .3 new FTE) - Dickinson

North Dakotans support current production agriculture, but also see a need to explore long-term sustainability. The Dickinson REC is exploring new sustainable agricultural opportunities through research and Extension efforts, including coordination of the Professional Development Program sponsored by the USDA Sustainable Agriculture Research and Education Program. These research and Extension programs will help rural North Dakotans develop new sustainable systems to enhance the economic viability of rural areas and to meet their economic, social and environmental needs within a diversified agriculture. Additional support for these efforts is needed, as is a strong program of direct outreach to farmers and ranchers. One sustainable agricultural specialist (70 percent Extension, 30 percent research) is needed at Dickinson to provide this support and outreach to southwestern North Dakota.

2005-07 Impacts

The North Dakota Agricultural Experiment Station develops and disseminates technology that is vital to the production and use of food, feed, fiber and fuel from crop and livestock operations.

To do that, the Agricultural Experiment Station has eight Research Extension Centers strategically placed throughout the state. Researchers at these centers work on solving problems the state faces and test new management techniques and crop varieties. The centers are the Main Station in Fargo, Agronomy Seed Farm (Casselton) and the Carrington, Central Grasslands (Streeter), Dickinson, Hettinger, Langdon, North Central (Minot) and Williston Research Extension Centers.

The centers work with the NDSU College of Agriculture, Food Systems, and Natural Resources' nine departments: Agribusiness and Applied Economics, Agricultural and Biosystems Engineering, Animal and Range Sciences, Cereal and Food Sciences, Entomology, Plant Pathology, Plant Sciences, Soil Science and Veterinary and Microbiological Sciences.

■ Variety Development

1. Developing hard red spring wheat (HRSW) with improved resistance to scab has been an ongoing effort for many years. Alsen HRSW, which possessed a reasonable level of scab resistance, quickly became established as the predominant spring wheat variety grown in the state the last several years. In 2006, Alsen remained the most highly used variety, planted on approximately 24 percent of the state's HRSW acreage.
2. Several new HRSW wheat varieties, Steele-ND, Glenn and Howard, also possess levels of scab resistance that will be useful for growers to combat this disease. Steele-ND uses a source of resistance from that is different from that of Alsen, and is from a wild relative of wheat. The resistance of Howard is similar to that of Alsen, but Howard has better overall disease resistance, higher yield potential and improved quality traits. Glenn combines the resistance of Alsen and Steele-ND, and also has excellent yield potential, better resistance to foliar leaf diseases and excellent quality traits. Initial production of this variety by North Dakota farmers suggests that Glenn will become the predominant variety as seed availability meets demand.
3. Three new durum wheat varieties, Divide, Grenora and Alkabo, all possess excellent yield and highly superior quality traits, with very good disease resistance. Reaction of these three durum wheat varieties to scab is better than any commercially available variety, yet not to the level of Alsen. Divide durum has the best scab resistance of the three, and is better adapted to eastern and central North Dakota, while Alkabo and Grenora are best suited to western North Dakota.
4. Stellar, a six-rowed barley variety developed for the malting industry, is in final stages of trials for acceptance by a major U.S. brewer. Stellar already has been accepted by other U.S. brewers. This variety, developed in part through the Western Malting Barley Project, is adapted across an extremely wide range of North Dakota environments and has excellent disease resistance, very good quality traits, and excellent agronomic and yield traits. In some dry to very dry

areas of North Dakota during the 2006 growing season, Stellar performed exceptionally well, with yields well in excess of 100 bushels per acre. This yield performance, particularly during such difficult growing conditions, has stimulated renewed interest in barley production in many areas of North Dakota.

- The rapid expansion of corn acreage into northern parts of North Dakota are due, in part, to the wide availability of early maturing, adapted parental lines. The corn breeding/genetics program at NDSU is the most northern corn improvement program in the world, focusing on identifying inbred lines expressing high yield potential in early maturing backgrounds, combined with rapid dry-down, to reduce drying costs after harvest. These inbred lines are made available to breeding programs in the hybrid seed corn industry.
- The Beef Systems Center of Excellence has the objectives of enhancing and expanding North Dakota's beef industry, providing training and educational opportunities for students and the industry, and enhancing North Dakota State University's ability to provide leading research for the state's beef industry. North Dakota Natural Beef LLC (NDNB) was formed and raised \$4.1 million in equity. A contractual arrangement was made between NDNB and NDSU and a facility was purchased by NDNB to house the Beef Systems Center of Excellence. Surveys have estimated that finishing and slaughtering cattle in the state could add \$400 million annually to the state's agricultural economy. The research associated with this center should lead to the information necessary to increase the number of cattle finished and slaughtered in the state, and improve the profitability of beef production in the state.
 - Plant pathologists and plant breeders are working as a team to identify new sources of resistance to crop diseases and develop improved varieties using these sources of resistance. These teams of scientists are working diligently to develop varieties with resistance to scab, wheat and stem rust, root rots, white mold, black leg of canola, potato diseases and diseases of other crops important to the state's economy.
 - Some of the greatest opportunities for North Dakota agriculture involve oilseeds. Ag biotechnology traits are essential to the future productivity and ability to meet new specialty uses. Current research has focused on increasing returns to canola. Improved selection in canola breeding indicates the ability to improve oil content per acre by about 16 percent to 18 percent, increasing per-acre returns from about \$200/acre to \$250/acre. Improved varieties would improve the comparative advantage of canola relative to other North Dakota crops and improve farmer returns.
 - The North Dakota Agricultural Weather Network (NDAWN) is a highly visible and widely used product supported by NDSU scientists. The network reports current and past climatic data from 70 statewide stations. This information is used by all agricultural interests and also by diverse groups, such as law enforcement agencies, construction and manufacturing firms, insurance and retail businesses, health officials and the U.S. military. NDAWN annually receives more than 2 million inquiries for weather-related data. Efforts to improve upon the cereal disease forecasting system have continued; improved epidemiological and weather data are incorporated into the model, which gives farmers greater reliability in determining whether to spray for disease control. NDSU scientists, working with colleagues in other states, increased the accuracy of the model predicting scab infection to 80 percent. The model can be accessed either by telephone or via the Internet; the Web site had more than 7,000 inquiries per year during the last four years, again an indication that NDAWN is widely used by citizens of the state. Other forecasting models exist for a number of diseases affecting crops in North Dakota.
 - Recent evidence suggests that the nutrition available to the growing fetus in livestock impacts the longevity and health of the offspring even into adulthood. The placenta plays a major role in the regulation of fetal growth. In all domestic livestock species, offspring born at an above-average weight have a better chance of survival than those born at a below-average weight. Placental nutrient transport efficiency is directly related to blood flow to the pregnant uterus. Therefore, an understanding of



NDSU corn breeding research has contributed to the rapid expansion of corn acreage into northern North Dakota.

factors that impact uterine blood flow will directly impact fetal growth. Future technologies based on basic information provided from this research could be used to optimize maternal-fetal nutrient exchange, and fetal development and subsequent longevity, productivity and marketability of livestock.

- Plant pathologists worked with federal and state agencies to obtain Section 18 emergency exemptions that allow producers to legally apply several fungicides to control crop diseases. Without such exemptions, these pesticides would not be available to combat crop disease problems. An example of the impact of one Section 18 exemption is that of Follicur, which in 2005 was applied to more than 1 million acres of wheat and barley, saving more than \$25 million in reduced yield and quality losses to these crops.
- Soil scientists, working in conjunction with agronomists and plant breeders, have developed efficient evaluation techniques to determine the reaction of soybean varieties to iron deficiency chlorosis. Soybean farmers can reduce the impact of this yield-reducing abiotic stress by using appropriate soybean varieties, resulting in improved yields and increased revenue.

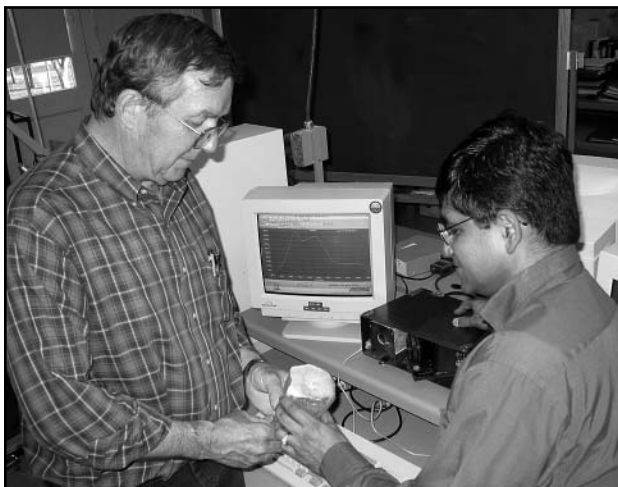


Scientists in NDSU's Center for Nutrition and Pregnancy study the effect of pregnant ewes' nutrition on their fetus's health.

- Continued research in the development of practical methods of assisted reproductive technologies in the domestic livestock industry should lead to improvements in reproductive efficiency, as well as breeding improvement programs through the use of embryos with specific genetics, importation and exportation of animals in the form of frozen embryos, and production of transgenic animals with highly desirable genes.
- Prior to 1998, leafy spurge was doubling in areas of infestation every 10 years. In the last several years, leafy spurge infestations in North Dakota have remained steady or declined slightly. This major accomplishment, significant to farmers and ranchers throughout the state, was achieved through an interdisciplinary research effort that identified appropriate pesticide use, appropriate grazing techniques and use of flea beetles as an integrated effort for controlling this invasive species. As leafy spurge concentration is reduced in pasture or rangeland, an increase in desirable range species occurs, thereby enhancing the carrying capacity of the land.
- NDSU scientists are leading the way in site-specific agriculture. The practice of applying only the precise amounts of nutrients and pesticides required to maximize yields results in more cost-effective production by the grower and a vast reduction in chemicals introduced into the state's ecological systems.
- Agricultural engineers and soil scientists are working to investigate the possibilities of using excess water from the Devils Lake basin for crop irrigation purposes. A detailed map of the soil properties in the surrounding region will provide information needed to better understand the soil-water compatibilities for irrigation purposes.
- Research considered the optimal segregation and marketing strategies to maximize the ability to capture premiums for North Dakota crops. Results for hard red spring wheat found the value of segregating by variety is about 10 cents/bushel (bu) and, if buyers specify contracts with functional requirements, the value increases to about 20 cents/bu.
- A biodiesel processing model was developed that was used to perform economic analyses of biodiesel production from canola and other oilseeds. The expertise gained through systems modeling enabled the efficient production of canola biodiesel used for demonstration purposes at the North Central Research Extension Center to educate the public on canola biodiesel.

IMPACTS: North Dakota Agricultural Experiment Station

- A sensitive method was developed to measure sensory quality of flaxseed oil. This method is needed to establish oil processing and storage parameters to ensure acceptable sensor quality, and may be adapted to other flaxseed foods. This methodology will be instrumental in enhancing the use and demand for flax products for human food, resulting in increased production of flax in North Dakota.
- Preliminary research indicates potential economic benefits from the development of a biorefining industry that would use wheat straw as feedstock to produce ethanol, cellulose nanofibers and electric power. North Dakota Agricultural Experiment Station scientists found that wheat straw is a preferred feedstock for a biorefinery, as it has a higher content of both cellulose and lignin and can be supplied at a lower cost than alternative feedstocks (e.g., corn stover, switchgrass). A biorefinery producing 50 million gallons of ethanol per year would use 900,000 tons of wheat straw annually, employ 77 workers and result in more than \$50 million in annual payments to North Dakota entities. Adding production of cellulose nanowhiskers, a structural material with industrial applications, to the biorefinery would add jobs and enhance profitability.
- A sensor was developed to determine the sugar content of sugar beets during the harvesting process. This could aid the efforts under way in site-specific sugar beet production. Using similar technologies, a sensor was developed to determine the protein content of wheat during harvest. This is a tool that could be used for site-specific farming and potentially could allow farmers to identity preserve the wheat crop based on quality parameters.
- Entomologists have found that using reduced rates of insecticide for wireworm control in areas of low root maggot pressure resulted in savings to sugar beet growers of more than \$1 million annually, as well as reducing the use of organophosphate insecticides by about 750,000 pounds. This strategy is used on more than 250,000 acres of sugar beet production in North Dakota. Evaluation of new seed treatment products also may result in broad spectrum control of sugar beet insect pests at no additional cost to the farmer, eliminate the use of more than 3.5 million pounds of organophosphate insecticide annually and be safer to the grower and ecosystem.
- The Veterinary Diagnostic Laboratory (VDL) plays a significant role in the state's livestock industries and also public health. The VDL is a member of the National Animal Health Laboratory network and has the responsibility for federal testing, as needed. The VDL typically handles approximately 10,000 cases annually, and also is integral in the surveillance program for West Nile virus. During the 2006 outbreak of anthrax in cattle, the VDL implemented a rapid, sensitive laboratory test that reduced diagnostic time to a few hours. The VDL continues to investigate state-of-the-art diagnostic techniques that improve efficiency and accuracy while reducing time and cost.
- Winter grazing is practiced by many livestock producers in the northern Plains in an effort to lower winter feed costs. Dormant-season grazing, while not an exclusive winter-grazing period, is defined as grazing between plant quiescence in late fall and green-up in early spring. The direct effects of dormant-season grazing on individual plant species versus conventional seasonlong use is not well defined. Present research indicates that two dominant native grasses, western wheatgrass and blue grama, are unaffected or benefited by dormant-season grazing, compared with full-use (50 percent disappearance), seasonlong summer grazing. Incorporating a brief early summer grazing period on winter-grazed pastures appears to be able to increase land productivity and reduce economic losses through increased livestock stocking rates.
- Evidence suggests that biological mechanisms regulating normal growth, development and nutrient utilization are programmed in utero for postnatal growth and adult function. Research is investigating maternal nutrition and high selenium effects on tissue vascularization, fetal growth, postnatal growth and end-product quality. Results from this research effort will provide new knowledge in the area of vascularization of key nutrient-transferring tissues, which should lead to improved animal production through the identification of the biological mechanisms controlling growth, metabolism and availability of dietary nutrients in agriculturally important livestock species.



NDSU researchers developed a sensor that can determine sugar content in sugar beets in the field.